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ABSTRACT

This instructional guide contains 16 activities designed to help teachers familiarize their students with the forest resources of Illinois. Each activity is ready to be copied and given to students. Topics of the activities, which vary in format, include: an overview of past and present Illinois forests; organization and mechanics of a forest ecosystem; food webs; plant reproduction; forest shelters; mammal tracks; nutrient element cycling; ecological principles; life cycle of the flying squirrel; forest management; working as a forester; preparing a timber stand improvement plan; and land use planning. Although the materials are probably best suited for students in grades 4-8, most of the activities can easily be adjusted to match the skill level of nearly every primary and secondary grade. (JN)

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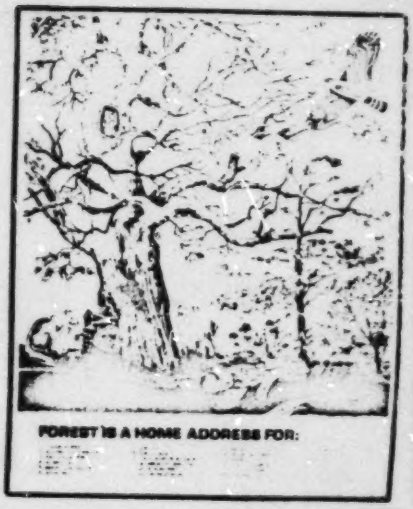
ILLINOIS NATURAL HERITAGE CONSERVATION EDUCATION KIT II



SPECIAL THEME

FOREST ECOLOGY AND MANAGEMENT

ILLINOIS DEPARTMENT OF CONSERVATION •
ILLINOIS STATE BOARD OF EDUCATION

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Illinois Natural Heritage Conservation / Education Kit II

ABOUT THIS EDUCATIONAL KIT: The special theme of this kit is FOREST ECOLOGY AND MANAGEMENT. The 16 exercises and activities included in this instructional guide are designed to help teachers familiarize their students with the forest resources of Illinois. Although the materials are probably best suited for students in grades 4-8, most of the exercises can easily be adjusted to match the skill level of nearly every primary and secondary grade.

NATURAL HERITAGE MONTH: As Natural Heritage Month in Illinois, April presents itself as a good time for teachers to use the contents of this kit. Natural Heritage Month includes the observances of Earth Day, (usually the third Tuesday), Arbor and Bird Day (the last Friday) and Bird Appreciation Week (the last week). Though the activities and exercises in this kit can certainly be used in relation to these special days in April, the materials are always topical and can be used at any time of the year.

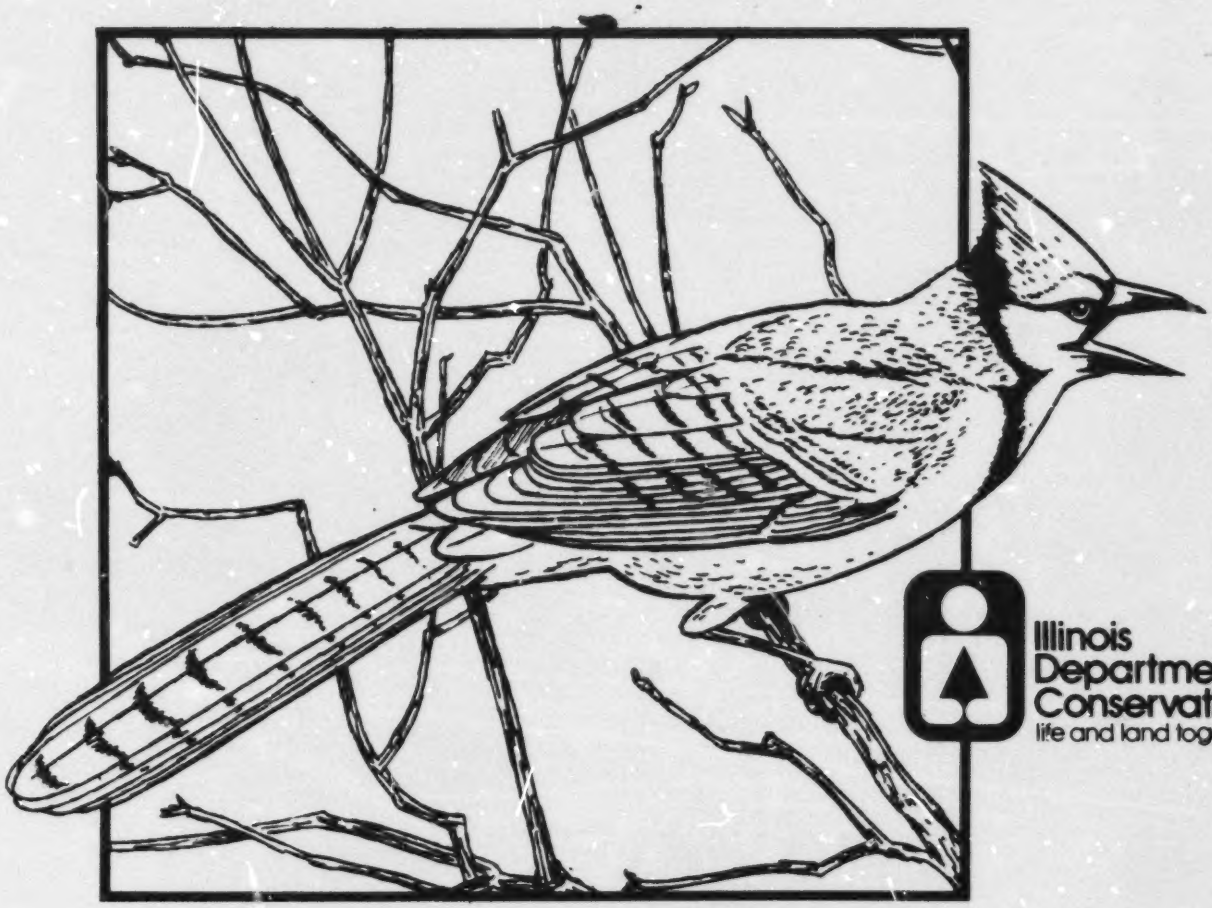
GIANT HABITAT COLORING PAGE: A special feature of this kit is the inclusion of a forest coloring page which features 25 native Illinois plants and animals. The coloring page serves as an important visual reference for students as they complete exercises in the instructional guide.

STEP INTO THE WILD: Students who complete the "ILLINOIS' FOREST RESOURCES AND YOU — A Planning Questionnaire" on page 3 of the instructional guide are asked to mail their completed questionnaires to the ILLINOIS DEPARTMENT OF CONSERVATION at the address shown below. Students who mail in a questionnaire will receive the conservation button entitled, "STEP INTO THE WILD" for their own keeping. To speed mailing teachers are asked to gather questionnaires and send them in together as classroom sets.

LET US HEAR FROM YOU: Teachers and resource interpreters who use this kit are asked to please complete the TEACHER QUESTIONNAIRE included in this kit. Since this kit is only the second in a five part series of conservation/education kits, the comments and suggestions we receive from the teacher questionnaires will be very helpful as we prepare the remaining three kits. Please help us make these educational materials useful and interesting by completing the questionnaire and mailing it to the address below. To show our appreciation, we will send a classroom set of GIANT HABITAT COLORING PAGES to each teacher or resource interpreter who sends in a questionnaire.

Illinois Department of Conservation
life and land together

Communications Program
Division of Forest Resources and Natural Heritage
524 South Second Street
Lincoln Tower Plaza
Springfield, Illinois 62706



Illinois Department of Conservation
life and land together

This Illinois Natural Heritage Conservation Education Kit is jointly sponsored by the Illinois Department of Conservation and the Illinois State Board of Education and is approved by the Illinois Advisory Board of Conservation Education. Materials in the kit were prepared by Sally F. Stone, Communications Coordinator, Division of Forest Resources and Natural Heritage, Illinois Department of Conservation. Illustrations were provided by Robert F. Eschenfeldt, Squires Ad Agency and Art Studio. Technical editors for the project included the following Illinois Department of Conservation staff persons, William E. McClain, Natural Heritage Biologist; Richard H. Thom, Staff Forester; Carol J. Mahan, Mammal Ecologist; Dennis Tucker, Resource Planner; James S. Allen, Fisheries Biologist; Grant Haley, District Forester; Melissa Scanlon, Natural Heritage Assistant; Vernon Kleen, Avian Ecologist; and Carl N. Becker, Natural Heritage Section Manager. Special appreciation is extended to Victoria Little for typing the manuscript.

This kit is fully endorsed by the Environmental Education Association of Illinois "as a sound conservation education kit that will increase awareness of the value of forests and other renewable resources and contribute to a strong environmental ethic on the part of the future citizens of Illinois."

Environmental Education Association of Illinois
L.T.F.C., Box 299
Oregon, Illinois 61061

Illinois State Board of Education
100 N. First St.
Springfield, IL 62777
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TEACHER QUESTIONNAIRE

A note to teachers and resource interpreters: This Natural Heritage Conservation/Education Kit is the second in a five part series of conservation education kits being produced by the Illinois Department of Conservation. You can help us continue to prepare quality materials for the remaining three kits by filling out the following questionnaire. You can also use this questionnaire to request classroom sets of the GIANT HABITAT COLORING PAGE featured in this kit. Mail your completed questionnaire to the address shown below.

Communications Program
Division of Forest Resources & Natural Heritage
Illinois Department of Conservation
Lincoln Tower Plaza
524 South Second Street
Springfield, IL 62706

Teacher's Name _____ Grade level _____

Name of School _____

Address _____

_____

Did you use the first Natural Heritage Conservation/Education Kit featuring "These Precious Few", Illinois' Endangered and Threatened Plants and Animals? _____ If yes, did you find the materials in that kit to be useful? _____

All of the exercises in the kit are ready to be copied and given to students. Do you like or dislike this "ready-made" format and please explain your answer. _____

_____

_____

* *

Please rate the exercises in this kit in terms of how useful they are to you as a teacher. In the space to the right of each exercise, rate the usefulness of each exercise by placing a 1 if you consider the exercise to be VERY USEFUL, a 2 for MODERATELY USEFUL, a 3 if you used the exercise and found it to be POORLY USEFUL and a 4 if you did not use the exercise at all.

Journal of Jim ____
The Way of the Woods _____
Spinning a Food Web _____
Plant Reproduction in the Forest _____
Fitting Together Plant Reproduction Cycles _____
How Seeds Move in the Forest _____
Forest Shelters _____
Tracking the Mammals of the Forest _____
Nutrient Element Cycling _____
The Family Tree _____
A Flying Squirrels Life to Live Game ____
Forest Sleuthwork _____
Forest Management-Making the Most of our Forests _____
Working As A Forester _____
Preparing a Timber Stand Improvement Plan ____
Land Use Planning _____
GIANT HABITAT COLORING PAGE _____

* *

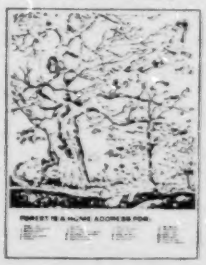
Please use this space to express any comments or suggestions you have about the kit as a whole or about any of its individual exercises. (If additional space is needed, please write on the back of this sheet) _____

_____

* *

Please use this space to order classroom sets of the GIANT HABITAT COLORING PAGE. The maximum we can send as a classroom set is 25.

_____Yes, I would like to order a classroom set of COLORING PAGES. Please send me _____ coloring pages.



You and Illinois' Forest Environment— A Planning Questionnaire

Dear Student:

For several years, the Illinois Department of Conservation has been asking citizens from all over the state to tell us how they feel about Illinois' forests. And we have been taking the ideas of those citizens and using them to prepare the ILLINOIS FOREST AND RELATED RESOURCES PLAN. Once this plan is finished, it will provide a blueprint for everyone in Illinois to follow if we are to make the wisest use of our forests. Now it is your turn to take part in developing this special plan. Please tell us how you feel about the forests in Illinois by filling out the questionnaire below. We will gather up your ideas and put them with the ideas of other students. Together, your thoughts and those of your fellow students in the state will be very helpful to us as the final draft of the FOREST AND RELATED RESOURCES PLAN is prepared. To show our appreciation for your help, we will send you a "STEP INTO THE WILD" conservation button for your own keeping when we receive your completed questionnaire.

Sincerely,

Allan S. Michelson
Chief
DIVISION OF FOREST RESOURCES
AND NATURAL HERITAGE

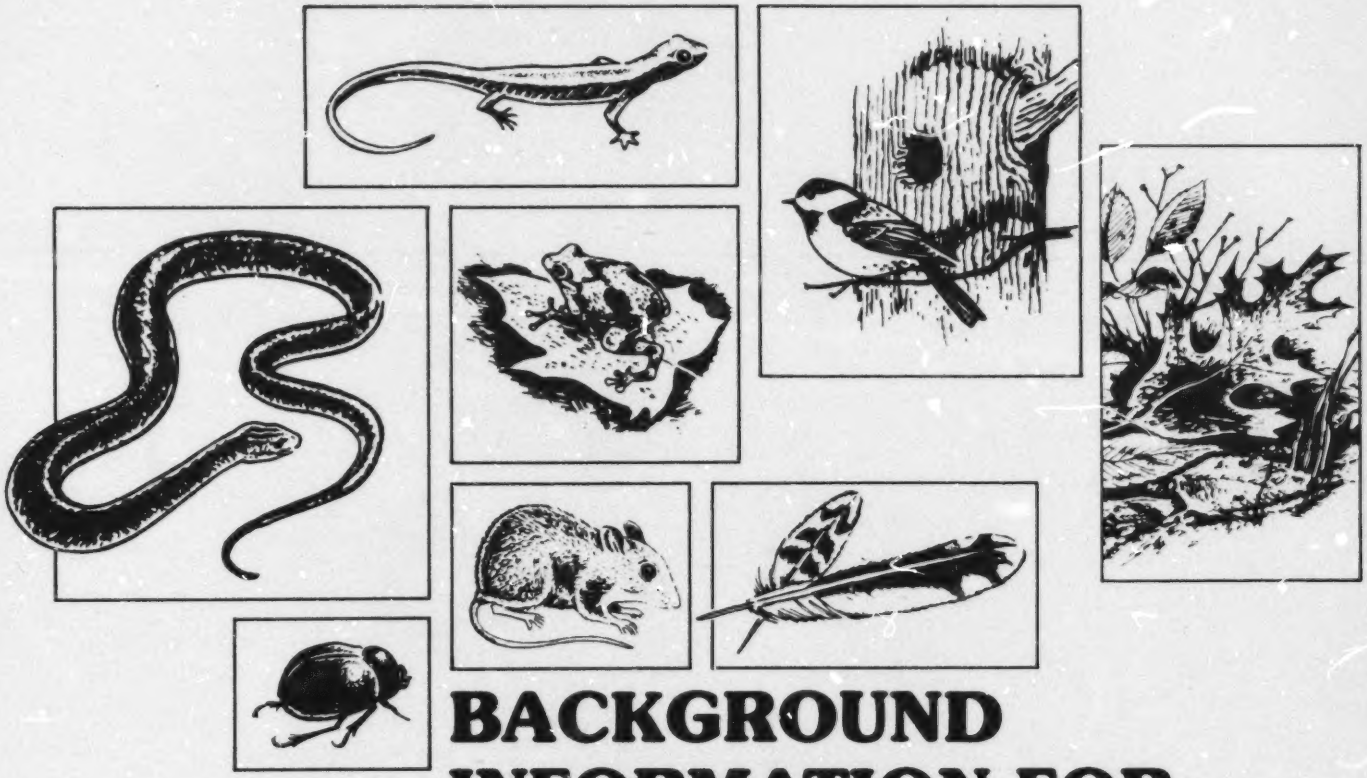
PLANNING QUESTIONNAIRE

To complete this questionnaire, please put an A in the space beside each statement if you agree with the statement and put a D beside each statement if you disagree.

1. The forests of Illinois are beautiful and important. _____
2. The trees in school yards, neighborhoods and in cities are just as beautiful and important as the trees in forests. _____
3. Forests are valuable because they provide a natural habitat for plants and animals. _____
4. Forests are also valuable because of the benefits they provide for people like wood products and opportunities to study nature, camp, hike and hunt. _____
5. The amount of forest land in Illinois that can be cleared to make room for cropland, houses, shopping centers, industries and roads should be limited. _____
6. Some forests, especially those that have not been disturbed by civilization, should be set aside and preserved as Nature Preserves and Natural Areas. _____
7. All forests, whether owned privately or included in a Nature Preserve, public park, or forest preserve, should be protected against vandalism, carelessly set fires, illegal off-the-road vehicle traffic and littering. _____
8. Forest animals should be protected against illegal hunting or poaching. _____
9. It is important to protect endangered and threatened plants and animals living in forests. _____
10. Some of the forests in Illinois should be harvested on a regular basis to produce wood for products such as paper, furniture, and building lumber. _____
11. When harvesting a forest, it is better to harvest some of the mature trees but leave behind a good supply of trees as growing stock and wildlife habitat than to harvest all of the trees at once. _____
12. Since the supply of forest in Illinois is limited and since the demand for forest is great, it is important to carefully plan the wise use of our forests. _____
13. The responsibility of taking care of Illinois' forests will some day be passed on to young persons such as yourself. _____

Your Statement about Illinois' forests: (Please write in this space how you feel about the forests of Illinois. Tell us what you like best about forests and what *you hope* the future will hold for Illinois' forests.) _____

(cut out)



BACKGROUND INFORMATION FOR TEACHERS

Each exercise in this instructional guide is ready to be copied and given to students. In addition, the instructions for each exercise speak directly to the student. The following includes support information teachers may find helpful when working with the exercises.

JOURNAL OF JIM (pages 6-10) This exercise is a fictional account taken from the journal of a young boy living and writing in modern day Illinois. The objective of "Journal of Jim" is to give students a broad overview of Illinois' forest resources by contrasting the ecological nature of Illinois forests with the past and present use of those forests. The "Journal" was chosen as the lead-off exercise in the kit because it introduces students through the eyes, spirit, and enthusiasm of someone their own age, to each of the themes explored more thoroughly in later exercises. A good follow-up activity would be to have students prepare their own journals by writing about a forest resource they are familiar with. That forest resource need not be as immense as the one Jim writes about, it could be a park, the trees in the school yard or even the tree(s) in a student's yard.

"THE WAY OF THE WOODS" (pages 11-12) The objective of this exercise is to familiarize students with the organization and mechanics of a forest ecosystem. The "Important Words" defined in this exercise are very important as they are used repeatedly in later exercises. Before students progress from "The Way of the Woods" to further exercises, they should have a good understanding of all of the terms used in the exercise and should be able to explain and discuss what makes a forest ecosystem "tick". This exercise must be used in conjunction with the Giant Habitat Coloring Page contained in each kit.

SPINNING A FOOD WEB (pages 13-15) The objective of this exercise is to acquaint students with the flow of energy through the forest ecosystem. Steps 1-3 of the exercise build upon the concepts of energy flow discussed in "The Way Of The Woods". Before the exercise is attempted, teachers may wish to review important terms such as *photosynthesis, respiration, herbivore, omnivore, carnivore, predator, prey, forage, food chain* and *food web*. This exercise can be completed as an individual project by one student, or as a class project by groups of students. For example, one group of students could handle the small mammals and another could handle the large birds of prey and so forth. A recommended extension to this exercise is to ask students to create circumstances that could possibly break strands of the food web. Students should then be asked to list the species that would be affected by possible disturbances of the food web. For example, students could list the species that would have less food to eat if one animal such as the rufous-sided towhee was illegally shot and thereby taken out of the food web.

PLANT REPRODUCTION IN THE FOREST AND FITTING TOGETHER PLANT REPRODUCTION CYCLES (pages 16-17) The objective of these exercises is to simplify for students the complicated process of plant reproduction. The drawing of a flower on page 16 can be used as a helpful reference when students attempt page 32 of the "FOREST SLEUTHWORK."

HOW SEEDS MOVE IN THE FOREST: (page 18) This exercise is directly related to the two preceding plant reproduction exercises. The objective of this exercise is to acquaint students with the different ways fruits and seeds travel from their parent plants to the soil. This exercise also attempts to show the interrelationship between plants and animals and the natural elements of wind, and water as it relates to seed dispersal. This exercise can easily be expanded to any other plant species by examining the structure of fruits and seeds to determine the way they are dispersed.

FOREST SHELTERS: (page 19) This exercise demonstrates the use of all parts of the forest by various forest animals. This exercise can be expanded by studying the life histories of additional forest animals to ascertain which part of the forest ecosystem they depend upon for shelter.

TRACKING THE MAMMALS OF THE FOREST: (page 20) This exercise has both a field and classroom application. The entire exercise can be done in the classroom and the completed exercise can be used as a field guide by students as they work on page 31 of FOREST SLEUTHWORK.

NUTRIENT ELEMENT CYCLING: (pages 21-23) This is one of the more difficult exercises of the kit. The broad objective of this three-part exercise is to demonstrate the absolute link between forest ecosystems and the recycling of nutrient elements on earth. The difficulty level of this exercise can be adjusted by teachers to match the skill level of their students by filling in parts of the cycles (water, oxygen and carbon) prior to giving the exercise to students.

THE FAMILY TREE: (pages 24-27) This play reinforces all of the ecological principles that have been presented in previous exercises of the kit. The play can simply be read aloud by students assigned to the different characters or it can be acted out by students.

A SOUTHERN FLYING SQUIRREL'S LIFE TO LIFE GAME (pages 28-30) This game provides an in depth study of the southern flying squirrel. In the game, the details of the flying squirrel's life history are divided into categories. Being able to recognize the different categories is the most important ability students will need as they progress through the game. Therefore, it is recommended that teachers familiarize their students with the type of information each category contains.

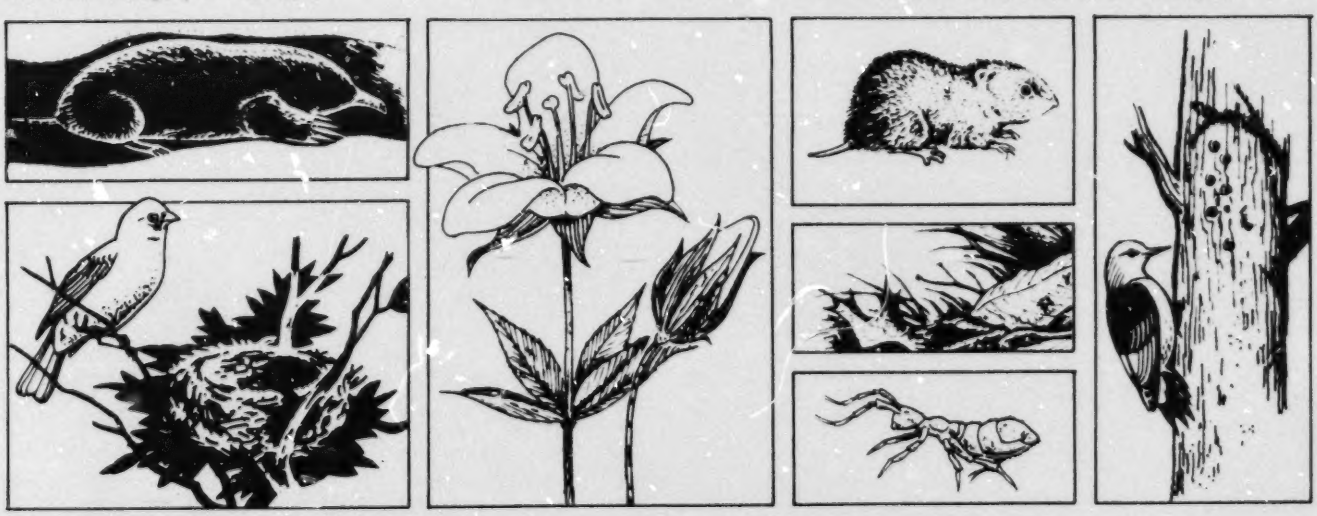
FOREST SLEUTHWORK (pages 31-35) This is the primary outdoor activity of the kit. The four locations the students visit in the exercise are first introduced in "The Way of the Woods" on pages 11-12. Teachers may wish to review that exercise and specifically the four locations or layers of the forest before sending their students out into the field for "Forest Sleuthwork".

FOREST MANAGEMENT – MAKING THE MOST OF OUR FORESTS: (page 36) This is the introductory exercise to the forest management component of the kit (pages 36-41). Students should have a good understanding of why forest management is important and of the principles of forest management before moving on to the next exercise.

WORKING AS A FORESTER: (pages 37-38) This exercise further investigates the principles of forest management and allows students to practice those principles by working as a Forester. In this exercise the student (as a Forester) will recommend a forest management plan for the five landowners featured on page 38. This exercise can be expanded by creating and describing additional landowners. Students can then recommend a management plan to meet the needs of those landowners.

PREPARING A TIMBER STAND IMPROVEMENT PLAN (pages 39-41) In this exercise, students decide which trees to leave and which trees to remove as part of a Timber Stand Improvement Plan for the sample plot of forest on pages 40-41. There are no absolute right or wrong decisions the students can make in regard to which trees they recommend removing and leaving. Just as actual plans drawn up by different FORESTERS may vary to some degree, so might the plans prepared by various students. However, students should be encouraged to follow the RULES OF THUMB FOR A TSI PLAN as closely as possible even though the final decisions are up to them.

LAND-USE PLANNING (pages 42-44) This exercise is a class project that is carried out in an oral format. Although most of the instructions for the exercise are read aloud to the class by students, the italicized portions in parentheses provide special instructions for the teacher to monitor to make sure the class is following the intended course of the exercise. In the final step of this exercise, the students vote to choose the final location for the airport. An excelient way to extend this exercise would be to invite another class to hear the presentation of Steps 1-6. That class could then also vote for the location of the airport.



JOURNAL OF JIM

April 18, 1981

Dear Journal:

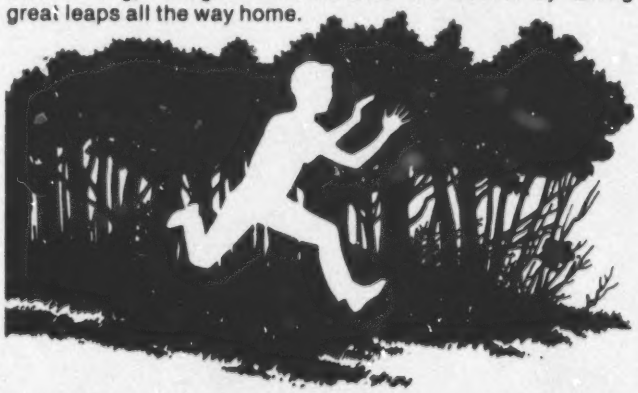
You are never going to believe it! I finally got to see one and it was FANTASTIC. Well, you know how all last month, I heard them yowling, meowing and squalling through the night. I read up on them at the library and figured a pair must be mating, and not far away, probably right here in our woods. For weeks now, I've been searching for signs of them. The claw marks on the big oak that stands on the edge of the clearing were my first real clues. I guess they scratch on trees sorta like Fluffy scratches on the sofa (Mother hates that so). Anyway, the last three days in March, it rained buckets, night and day without stopping. The first night of April was the first clear night and I went to bed pretty early. Deep in the night, unbelievable shrill screams raced into my ears and sent me running from my bed to the front porch. It sounded like the biggest cat fight in the world. Standing there, listening to the screams, hissing and low-mad-sounding moans, I came up with the theory that a strange female had wandered into the territory of the female who was making a home in our woods. The heavy rains must have washed away the urine our female had left as scent posts all around her territory, posts that meant to all strangers, especially other females, THIS IS MY PLACE—LEAVE ME ALONE. It was cold on the porch and I was shivering. As I jumped back under the covers, I thought about our female. I knew she was probably pregnant and I fell asleep hoping she would not be hurt or killed that night.

It was four days later that I found the tracks down by the creek. I knew Fluffy's little feet couldn't have made those big powerful-looking tracks, and besides, right by the tracks, were some fresh droppings. I bent down and picked apart the remains of what the big animal must have eaten the day before. I found what I figured to be the teeth of several mice, some bits of rabbit fur and part of the foot of a bird. Ever since the day I found those tracks, I have thought of nothing except getting a glimpse of the animal that left them.

And journal, it happened like this. I had been in the forest ever since I got home from school and the sun was starting to fall. I have always been afraid of the forest at night. To beat the darkness, I decided to take a short cut across the clearing. At the edge of the clearing I stopped for a second to look at the old oak. There were new claw marks but no time to spare studying them. As I turned from the woods to strike out across the clearing I saw a dark heap beneath a bush no more than twenty yards from me. It couldn't be, I thought and kept on. Then it moved and I dropped flat on my belly. It was! It was! It was standing up and stretching like a sleepy child. What happened next was spectacular.

Unaware of me and the sleepy heap beneath the bush, a long-tailed weasel came loping across the clearing. The bobcat crouched and froze. The weasel paused for a second and lifted its head to search the area. No motion detected — it continued with a slow gait but when it was about ten feet from the bush, it saw the big cat. Quicker than a flash, it turned tail and ran. But the bobcat was faster. With just three leaps the bobcat had the weasel by the neck. In a few seconds the squirming weasel was still and the bobcat proceeded to eat it, hind quarters first. For a split second, I felt sorry for the weasel but then I remembered the time I watched a weasel devour a rabbit. It's just the way the animals get their food and there's no waste or cruelty about it. When the big cat was through, it sat quietly and washed itself. Then a loud motherly call pierced the woods, "Jim, Jim, where are you?" Instinctively, I lifted my head to answer and the bobcat saw me. Before I could help myself, I stood up and thought about running, but it was too late — the bobcat beat me to it.

First trotting, and then leaping 7-10 feet at a time, it crossed the clearing and disappeared into the woods in nothing flat. It was dark by then and you know what, journal, I wasn't even scared of the night woods for the first time in my life. Yes, I was trembling but not from fear, from excitement, and as I raced along, I laughed and imitated the bobcat by taking great leaps all the way home.



So you see, journal, the forest proves time and time again to be the best friend I have. Mom and Dad say we are lucky to own so much forest land, just over 300 acres. On our land we have most of the trees that are the most common in Illinois like the different species of oak, ask, hickory, and maple. Down along the river you can find some pretty large trees like sycamore, sweet gum, cottonwood, black willow, slippery and american elm and one of my favorites, pecan. River birch,

silver maple and box elder are also some wet soil trees that manage to hit the 75-100 foot high mark. Medium to small-sized trees like red mulberry, blue beech and sandbar willow also grow pretty good down in the bottomland. Once you leave the bottomland, the forest turns upland and you can find trees like sugar maple, basswood, red bud and paw paw, a tree that grows in thickets. Along the ravines, honey locust is pretty common and on the slopes white ash, white oak, pignut hickory, and red maple seem to take over the forest. On our northern-most property, we have some pretty steep slopes and ridges where you can find bur oak, hop horn beam and shadbush. Quite a bit of our land borders onto farmland, and along the fences that separate the forest from the fields, osage orange, wild black cherry, persimmon and Iowa crabapple are common. Every once in awhile, especially around an opening in the forest, you can find red cedar. Red cedar is one of the few native coniferous species of Illinois. A coniferous tree does not shed all of its leaves every fall like the deciduous trees. Coniferous trees usually have leaves that look more like needles. The great majority of Illinois' trees are deciduous but you can find coniferous trees such as tamarack in northeastern Illinois and bald cypress in southern Illinois.

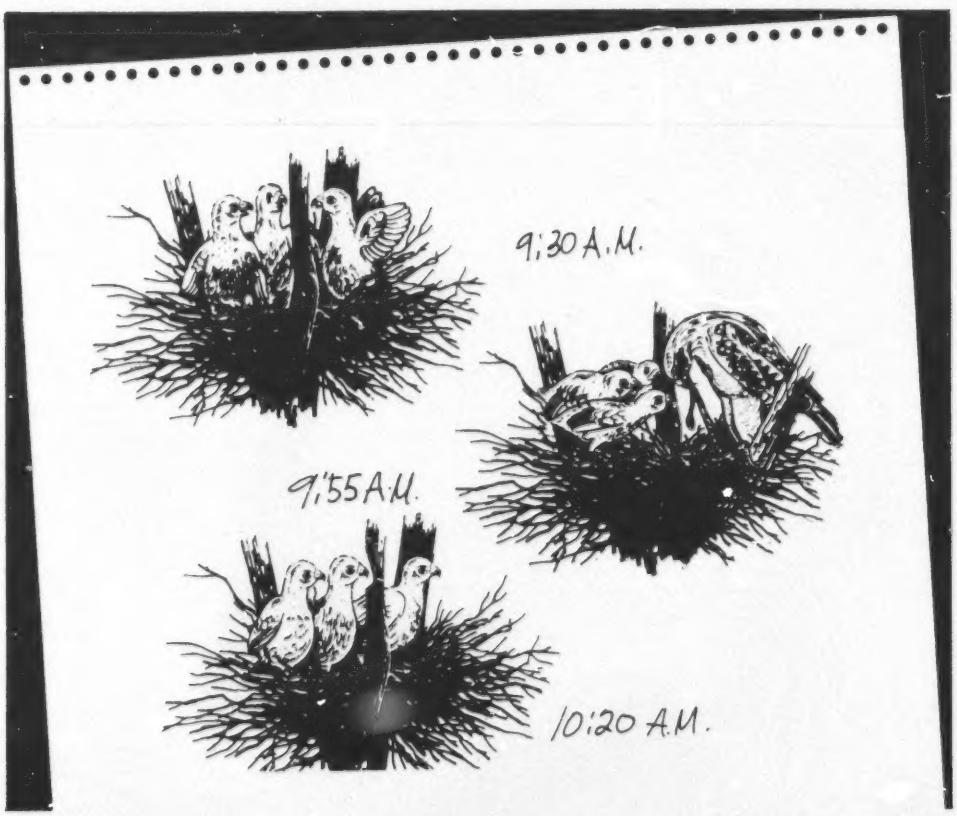
I almost forgot to mention my mother's pride and joy, the forty acres of white oak just south of the house. Back in 1821, my mother's great-great-grandfather was one of the first settlers from the East to stake a claim in the Illinois Country. The story is that when he saw that forty acres of white oak, he fell in love with the big trees and decided to build his cabin right beside them. Do you know journal that when my great-great-great-grandpa first laid eyes on those oaks, some of the trees were already 200 years old. Well, his cabin is gone now, our house stands in its place, but many of those old trees are still standing alive and well, even though they are over 350 years old.

Illinois was very different when my great-great-great-grandpa settled here. Back in his day, there was a great deal of forest in Illinois, just over 14 million acres. But when my grandfather was born in 1901, just 4 million acres of forest were left. When our district forester came around last fall to inventory our forest, he told me there was only about 3.2 million acres of forest left in Illinois.

Sometimes when I'm out in the woods spying on a brown thrasher nest or collecting seeds to take to the nursery, I wonder how more than 10 million acres of forest could have disappeared from our state. I know better really. I know all that forest didn't really disappear. The land it stood on is simply used for different things now. I figure most of it is used for farmland. When the settlers moved into Illinois, they saw how the soil beneath the forest grew big, healthy trees and they decided the same soil would grow good crops of corn and soybeans. And since they had to make a living they started clearing forest to make cropland and the clearing has never stopped. Why, just this last fall, they cleared 60 acres of good forest just a few miles from here. Even the fencerows of timber running between the fields are being taken out. The new highway they laid north of here took a bunch of timber and so did the new shopping mall on the outskirts of town. Even at the school, forest was lost when they put in the new playing field. So you see, journal, every time something new needs to get built, there's a chance for losing more forest. I just hope there's always enough forest for wildlife to have a home and for people to enjoy.

We get a lot of enjoyment out of our forest. During the winter, my sister and I cross-country ski and during the warmer weather, we hike and go on picnics. My pa says I'll be patient enough to hunt for turkey in a few years (I'm glad he didn't see me jump in front of that bobcat). I already hunt for rabbit and squirrel and my pa traps for foxes and raccoons. Last year, he shot a 85 lb. buck with a bow and arrow.

Some of my favorite hunting is done with a pair of binoculars and I write down and draw my trophies in you, journal. Remember this entry for May 15, 1980.



9:30 A.M. Oh, lucky day. I've found a red-shouldered hawk nest. Three downy young are standing up in the nest, flapping their wings, screaming and watching the sky. They must be hungry but there is no sign of an adult.

9:45 A.M. The adult hawk arrived at the nest and dropped the body of a mouse. But the young hawks didn't even touch the mouse and the adult took off.

9:55 A.M. The adult returned with a snake in its talons. The big hawk tore the snake and the mouse into tiny bits. The young hawks are now taking the bits of food from her bill. The biggest one keeps crowding the other two out. I hope they can all get enough food!

10:20 A.M. All is well. All three ate until their crops were bulging out and they turned away from the adult and stood peacefully on the edge of the nest. The adult gobbled down the last bits of food and flew away (I bet to do some more hunting).

Yeah, you better believe it. Watching those hawks made me feel like a real forest sleuth. I've spied on so many of the forest creatures. I've watched a male eastern gray tree frog singing with its vocal pouch puffed out big like a trumpet. One early June morning, I watched a snapping turtle crawl from the water into the forest where she dug a hole and laid her soft shelled eggs. Once, I saw a viceroy caterpillar loop along the limb of a cottonwood and when I touched it, it stopped dead in its tracks and imitated a twig. I've gotten to see a monarch butterfly bust loose of its green jewel-like chrysalis. I guess one of the neatest times was when I spied a cicada nymph scrambling up the trunk of a dogwood. It positioned itself on a branch and laid still until its shell cracked open and a winged adult crawled out and flew away. Do you realize journal, that cicada nymph had been in the soil growing and changing for seventeen years before it climbed that dogwood and flew off as an adult.

Trees and animals aren't the only things in the forest. There are lots of fungi like true morel, ear fungus and hen of the woods. You can find different varieties of moss like silky fork moss that grows on hillsides and ostrich plume moss which grows on old logs. Down in the bottomland especially, you can find ferns like common adder's tongue and rattlesnake fern. But I guess the prettiest part of the forest are the wildflowers. My mother is a wildflower expert and every year, sometimes as early as February, she has me out in the woods to catch the blooming of harbinger of spring, usually the first wildflower to bloom. In March we look for the blossoms of yellow dog's tooth violet and blue cohosh. And then from April to June you can spy all kind of blooming flowers like sweet cicely, white violet, jack in the pulpit, fire pink, wild columbine, and one of mother's favorites, green dragon.

We have one wildflower called goldenseal in our forest that is fast becoming rare and is classified by the State of Illinois as "threatened", which means it is in danger of becoming "endangered". If a plant is "endangered," it means it is in danger of becoming extinct. If a plant becomes extinct, no one will ever get to see it again. All together there are 72 animals and 364 plants listed as threatened or endangered in Illinois. The main reason why many animals and plants are "endangered" or "threatened" is because so much of their natural habitats, including forests, have been destroyed or changed. The bobcat I saw this morning is a "threatened" animal.

I guess what it all boils down to is that we need to take good care of our forests and the plants and animals in them. One of the ways we take care of our forest is by preventing fire. We are very careful with any type of burning we do whether we're burning trash up by the house or whether we've got a campfire going out in the woods. Did you know journal, 9 out of 10 forest fires are set carelessly by people and that thousands of acres of forest burn in Illinois each year.

We also care for our forest by not grazing it with cows. If you let cows out on a forest, they eat off the young trees trying to grow. Plus, the cows beat down the wildflowers, fungi, mosses and even the soil. As a result, the packed down soil can't hold water very well and pretty soon, the soil of the forest is running down and filling up some nice stream or river. Of course, we have cows but we keep them in a pasture where they belong. Some insects can also harm a forest and we work with our forester to keep those insects under control.

Probably the most important way we protect our forest is by not overcutting it. Sure we select some of the mature trees to harvest every year but we leave back a good supply of trees as growing stock. The type of harvesting we practice is called *selective harvesting*. We harvest our forest in this way to guarantee that there will be more trees to harvest later and so that there will always be plenty of trees to provide food and shelter for the forest animals. Some of the wood we harvest we use ourselves to build the things we need like the new porch on our house. The rest of the wood we sell to the mill. Our wood is eventually used all over the country to build homes, schools, and furniture.

Another way we manage our forest is by practicing *timber stand improvement*. We improve the quality of our timber by removing some of the trees that our taking up too much space or are crooked, diseased or damaged. By taking out those trees it leaves more sunlight, soil, water and nutrient elements for the healthy, well-formed trees. Pa says that *timber stand improvement* produces a better crop of trees in the forest just like hoeing produces a better crop of vegetables in the garden. And besides, it sure provides plenty of firewood.

We pay special attention to Ma's forty acres of white oak. Since we want that stand to look just the way it did when my great-great-great-grandfather first saw it, we don't allow any cutting of those trees. That way, the old stand of oak will always be a living record of Illinois' natural heritage. I guess a harvest in the stand would bring in a lot of money but Ma & Pa say we'll never harvest it. You see, since we harvest the rest of our forest, we can afford to never touch the oaks. That's what good forest management is all about—making the most of the forests we have—so that we can have more of all of the things forests provide like a natural habitat for plants and animals, opportunities to hunt, picnic, camp and study nature and lumber to build and make the forest products we use so much in everyday life.

Taking good care of our forest has certainly paid off for us. The 260 acres of our forest that we harvest is registered as an Illinois State Tree Farm and six years ago, my ma & pa won the Tree Farmer of the Year Award. And just two years ago, our 40 acre stand of white oak was dedicated by the State of Illinois as a State Nature Preserve.

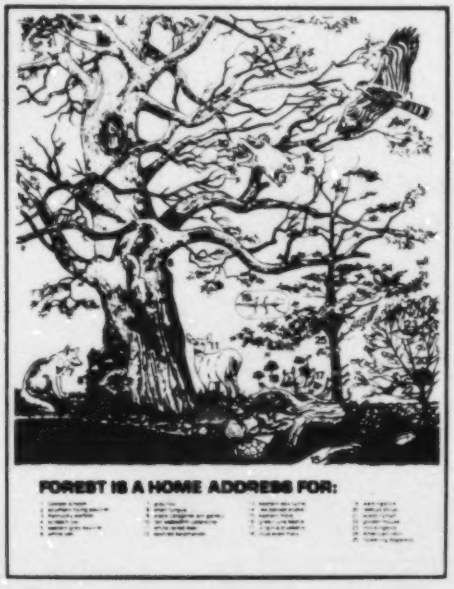
One time Pa and Ma had a long talk with me about how someday I'd be in charge of managing our forest. I could tell from the way they spoke that Ma was just a wee bit nervous about whether I'd take good care of her white oaks and green dragons and Pa was a might anxious about whether I'd keep the forest in good shape for the turkeys and the deer. I tried to reassure them that I would. I know that journals are supposed to be secret but one day I think I'll let them read this journal. Then they'll know for sure that I will always take care of the forest not only for the sake of the oaks, green dragons, turkeys, deer, bobcats, and red-shouldered hawks — but for the sake of us all. Good night journal.

THINKING FURTHER

1. How many acres of forest were in Illinois when Jim's great-great-great-grandfather first laid eyes on the 40 acre stand of white oak? How many acres of forest remained in Illinois when Jim's grandfather was born? How many acres of forest were left when the district forester visited Jim's forest in the fall before he wrote this account in this journal? How many acres of forest have been lost in Illinois since the early 1800's?
2. Jim writes in his journal about the different reasons why forests have been and continue to be cleared. Can you name some of the reasons Jim writes of? Can you think of some other reasons why forest is cleared? Jim writes that it seems to him that every time something needs to be built, more forest is lost. What does Jim say his hope for the future of forests is?
3. Name the tree species Jim says grow in the bottomland of his forest.
4. Name the tree species Jim says grow on the gentle slopes of the upland forest. What are the tree species that grow on the steeper ridges and slopes.
5. Jim writes that he and his family get a lot of enjoyment out of their forest. Name five activities Jim and the members of his family do in the forest that they enjoy.
6. Jim writes that he is forest sleuth. Name the animals he has spied on in the forest. Have you ever been a forest sleuth? What animals have you spied?
7. Jim writes that trees and animals aren't the only things in a forest. What are some more things found in a forest?
8. What is the name of the first wildflower that usually blooms in the spring? What is the name of Jim's mother's favorite wildflower? What is the name of the wildflower Jim says is listed by the state of Illinois as "threatened."
9. If a wildflower is listed as "threatened", what does that mean? What does it mean if a wildflower is listed as "endangered"? What does it mean if a plant or animal becomes extinct?
10. Jim writes that the bobcat is a "threatened" animal. In another part of his journal Jim spies on an "endangered" animal as it feeds its young. Can you name that animal? What is the main reason why many plants and animals are endangered in Illinois?
11. Jim writes that his family takes care of their forest by guarding against fire. Out of every ten fires, how many are set by the careless acts of humans?
12. Can you explain how grazing a forest with cows can harm it?
13. Jim writes that the 40 acre stand of white oak is a living example of Illinois' natural heritage. What does he mean by that statement?
14. Jim writes that his family is careful not to overcut their forest. What is the name of the type of forest harvesting their family practices? Describe the practice of timber stand improvement. Can you name at least 10 things that might be made from the wood that comes from Jim's forest. Don't forget to mention your pencil.
15. Jim writes that because his family carefully manages their forest, they are able to set aside some of it as a nature preserve and harvest other parts of it. In addition, Jim writes that because of their good management, their forest will continue to provide food and shelter for forest animals. Is that what Jim means when he says that the goal of forest management is to make the most of the forests we have?
16. Jim writes that he will someday be in charge of managing his family's forest. Do you think he'll do a good job?

THE WAY OF THE WOODS

To complete this exercise, you should study carefully the forest community depicted on the large FOREST IS A HOME ADDRESS COLORING PAGE. In the lesson below, there are blanks that you should fill in with the names of the 25 plants and animals shown on the COLORING PAGE. You will find clues as to the names that belong in each blank by carefully reading each paragraph. There are 27 blanks so you will have to use the names of two species twice. You will use the name of each species at least once. After you have filled in all of the blanks, begin the second exercise, IMPORTANT WORDS IN THE WAY OF THE WOODS. After you have completed these exercises, you should be familiar with the mechanics of a forest ecosystem or in plainer words "the way of the woods".



This insect resembles a twig because its body and legs are very long and slender. The HABITAT or home of the _____ _____ is commonly a forest.

The _____ earns its name by expertly mimicing the songs of other birds. This 9" long, gray bird with a white breast and wing patches is one member of the forest ECOSYSTEM. An ecosystem is a community of plants and animals living together and interacting with their habitat.

Even though the _____ _____ _____ _____ has a hard protective shell, it burrows beneath logs or rotting leaves during hot dry weather. The science that studies the habits of a living organism within its habitat is called ECOLOGY.

Energy first flows into the forest ecosystem in the form of sunlight. Green plants such as _____ _____, a wildflower with blue bell-shaped blossoms, capture sunlight through their leaves. Using the sunlight as energy, the plants combine water and carbon dioxide in the presence of chlorophyll to make glucose or food molecules. That process of making food molecules is called PHOTOSYNTHESIS.

Since animals cannot use the energy of the sun to make food in the same way green plants can, all animals are dependent upon plants as the PRODUCERS of food in the forest ecosystem. When a producer plant such as _____ _____, a small wildflower that has four blue petals to its blossom, is eaten by an animal, food molecules are transferred from the plant to the animal. Whether inside the tissues of a plant or an animal, food molecules must be broken down before they can provide energy to power the plant or animal's life functions. That breaking down of food molecules to release energy is called RESPIRATION. Carbon dioxide and water are given off as waste products of respiration.

Some animals eat only plant materials. The _____ _____, a 5 7/8" to 6 3/4" long mammal with golden upper parts and cream-colored lower parts, eats the seeds of trees. The _____ _____ _____, an insect that pitches a silky tent over the branches of a tree, eats leaves and buds. Because of their food habits, these species are called HERBIVORES.

Other animals eat only animal materials. The _____ _____ a 15½" long bird with a barred tail PREYS (or kills and eats) upon birds, small mammals, reptiles, amphibians and insects. The _____ _____ a 4¼" long bird with yellow underparts preys upon insects. The _____ _____ _____, a tiny black insect that lives in a colony, also FORAGES (hunts) for insects. These species are called CARNIVORES.

Still other animals eat both plant and animal materials. The _____ _____, a 8½" bird with a darkly-colored back and an orange breast eats worms, insects and the fruits of trees. The _____ _____, a 6½" to 8" mammal who uses its spadelike hands to burrow through the soil, eats roots, bulbs, worms and insects. These species are called OMNIVORES.

The golden mouse (a herbivore) feeds on the seeds of PRODUCER plants such as dogwood, wild cherry, pokeweed, clover and bittersweet. In turn, the golden mouse is preyed upon by the _____ _____, a 8" long, bright rusty, brown or gray bird that nests in hollow tree cavities. That bird is preyed upon by the fast and powerful Cooper's Hawk (also a CARNIVORE). The hawk is at the top of its FOOD CHAIN and is rarely killed by a natural PREDATOR (an animal that preys upon another). A FOOD CHAIN is formed when a PRODUCER is eaten by a HERBIVORE, who is then either eaten by a CARNIVORE or an OMNIVORE. In turn, that last predator may be eaten by a larger, quicker or better equipped CARNIVORE until the top of the food chain is reached. There are many food chains in the forest ecosystem. The combination of all the food chains represents the total feeding scheme within the ecosystem and is called the FOOD WEB.

The _____ _____ a large, hoofed, gray to brown mammal is hunted by people during regulated seasons. The _____ _____, a mostly gray colored mammal about 39" to 41" inches long, is also hunted and trapped by people during regulated seasons. When these animals are taken by people, people become part of the food web of the forest. Only certain animals of the forest can be hunted legally and they may be hunted only during posted seasons. To kill an animal other than those that can be legally hunted or to take an animal out of season, is illegal and punishable by fine and/or imprisonment.

The branches of the tallest trees such as the _____ _____ form the CANOPY LAYER of the forest. The CANOPY forms a protective umbrella over the forest, providing shade and shielding plants and animals from harsh weather. Much of the rain falling upon the forest is caught by the leaves of the canopy trees. Of course, those trees also return the most water vapor to the atmosphere as they undergo TRANSPIRATION (the evaporation of water from the leaves to the atmosphere).

Medium to small sized trees such as _____ _____ and shrubs such as _____ _____ form the UNDERSTORY AND SHRUB LAYER of the forest. The many branches of the trees and shrubs provide cover for birds and mammals. The flowers on trees and shrubs attract insects such as the _____ _____, a dark brown species that boasts two small yellow spots on each of its

front wings. Insects carry pollen from pistillate or female flowers to staminate or male flowers. The pollen then fertilizes the seeds in the ovary of the pistillate flowers and the process of POLLINATION is complete. In some cases, pollen is transferred by wind.

Wildflowers such as _____ _____ and _____ _____ make up the most visable portion of the HERB LAYER of the forest. Fungi and mosses are also found growing at this low layer.

The FOREST FLOOR LAYER is a good place to find forest amphibians such as the _____ _____, a 6"-7¾" long, darkly colored animal marked with round, yellow-orange spots and forest reptiles such as the _____ _____, a 8"-10" slender animal possessing a plain red belly and several dark spots about its neck. The FOREST FLOOR includes the soil that is rich with many hundreds of insects such as the _____ _____, a dark green species about 1 inch long. But the forest floor is more than a home for animals and a place for plants to take root. The forest floor is like the garbage can of the forest catching the fallen branches, fruits, seeds and leaves of plants, and dead animal remains. All of the debris that collects on the forest floor is called FOREST LITTER. Since nearly two tons of forest litter is collected on one acre of forest in just one year, it is very important that the forest does not choke on this debris.

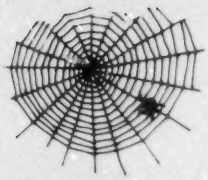
If the forest floor is like a garbage can for the forest, DECOMPOSERS are like garbage disposals. _____ _____, a fan-shaped whitish species that grows on dead wood is a DECOMPOSER. Decomposers are species which cause dead things and animal waste products to decay. The most important decomposers are fungi, bacteria and some insects. In a small area of the forest floor, there are billions of decomposers, some you can see, but 100 times more that only can be seen only under a microscope. Decomposers break down the forest litter until mostly only nutrient elements such as carbon, nitrogen, sulphur, and phosphorus are left. These elements, necessary for the growth of all living things, are stored in the soil until they are taken in through the roots of plants. As a result, the decomposers have taken nutrient elements from dead materials and waste products and recycled them so that they can be used again by living organisms. This is what is meant by the NUTRIENT ELEMENT CYCLING of the forest.

The NICHE of the _____ _____, a small mammal with thin folds of skins extending from its wrists to its hind feet, is foraging at night across the branches of trees for buds, seeds, nuts and fruits. This animal is preyed upon by larger animals and builds its nests in a hollow tree cavity. The niche of the _____ _____ _____, a small gray-colored mammal with a long bushy tail, is foraging across tree branches during the day for buds, seeds, acorns, nuts and fruits. This animal is also preyed upon by larger animals and builds either a leaf nest or settles into a hollow tree cavity. A NICHE is the particular function a species carries out within its ecosystem. To define a species' NICHE, one must consider where it travels, how and when, what it eats and what eats it, and what part of the ecosystem and what type of ecosystem it hunts and nests in. The niches of some animals may be similar but to make sure there is enough space and food for each animal, the niche of one animal is never exactly the same as the niche of another. For example, the niches of the two animals described above are very similar except for one thing. Even though the two animals may cover the same territory in search of food, one does so during the day and the other does so at night.

IMPORTANT WORDS IN THE WAY OF THE WOODS: Fill in the 24 blanks below with the 24 words appearing in bold face type in the previous exercise.

1. _____ the process whereby plants and animals break down food molecules in order to release energy to power their life functions. Carbon dioxide and water are given off as waste products of this process.
2. _____ this forms a protective umbrella over the forest, providing shade and protecting plants and animals from harsh weather.
3. _____ wildflowers make up the most visible portion of this layer.
4. _____ All of the materials that collect on the forest floor are known collectively as this.
5. _____ the verb that means one animal is killing and eating another.
6. _____ the home of a plant or animal
7. _____ the science of studying the habits of a living organism within its habitat
8. _____ green plants that manufacture food through the process of photosynthesis.
9. _____ this is formed by the understory trees and shrubs in the forest.
10. _____ this is the process whereby either wind or insects carry pollen from the staminate or male flowers to the pistillate or female flowers. The pollen fertilizes the seeds inside the ovary of the pistillate flower and the process is complete.
11. _____ the lowest layer of the forest that includes the soil and serves as a collecting point for leaves, logs, fruits, seeds and dead animal remains.
12. _____ an animal that preys upon another.
13. _____ a verb which means to hunt.
14. _____ animals that eat only animal materials.
15. _____ a community of plants and animals living together and interacting with their habitat
16. _____ the process whereby plants combine water and carbon dioxide in the presence of chlorophyll to make glucose or food molecules.
17. _____ animals that eat only plant materials.
18. _____ the total feeding scheme of an ecosystem.
19. _____ the evaporation of water from the leaves to the atmosphere.
20. _____ animals that eat both plant and animal materials.
21. _____ this is formed when a producer plant is eaten by a herbivore who is then either eaten by a carnivore or an omnivore. In turn, that last predator may be eaten by a larger, quicker or better equipped carnivore until the top of the food chain is reached.
22. _____ Species that cause things to decay. They are very important because they break down the forest litter until almost nothing is left except for important nutrient elements.
23. _____ The process whereby decomposers of the forest break down dead plant and animal remains to release nutrient elements such as carbon, nitrogen, sulphur and phosphorous. These elements are stored in the soil and are taken in by the roots of plants. Thus, the nutrient elements have been taken from dead plants and animals and are now ready to be re-used by living plants and animals.
24. _____ This is the particular function a species carries out within its ecosystem.

SPINNING A FOOD WEB



In the previous exercise, "The Way of the Woods" you learned that plants are the PRODUCERS of food energy in the forest ecosystem. Animals known as HERBIVORES get food energy by eating the parts of plants, mainly the fruits, seeds, buds, leaves, bark and petals. Other animals known as OMNIVORES get food energy by eating plant parts and other animals. Still other animals obtain food energy by eating only animals. Those predator animals are known as CARNIVORES. *If you were a spider and could spin a strand of silk from all of the animals in the forest to all of the plant parts and animals they eat, you would have a FOOD WEB.* Of course, you are not a spider and you have no silk, but no matter, you have a pencil, and that's all you really need to spin a FOOD WEB. HERE'S HOW:

Step 1. A forest ecosystem is drawn for you on pages 14 and 15 of this booklet. Tape the two pages together so you have a one big forest complete with 17 plants and 57 animals. For the largest plants, the parts that animals most often eat such as the buds, seeds, fruits, bark and leaves are drawn large and highlighted by a circle. Most of the plants and animals are not drawn to scale.

Step 2. Study the DIET CHART below. The chart tells you what types of plant material and what animals each animal normally eats.

Step 3. Return your attention to the forest ecosystem and select one animal. Now reread the diet of that animal and draw a line to every plant or animal that animal might possibly eat. For example, the diet of the great horned owl includes all animals except the large mammals and birds of prey. By checking the DIET CHART, you can see which animals are not commonly in the great horned owl's diet. Therefore, the correct move is to draw a line from the great horned owl to all of the animals in the forest ecosystem except for the large mammals and the birds of prey. To complete the spinning of your food web, take each of the animals in the ecosystem and draw a line to each plant part or animal it might possibly eat.

DIET CHART

SMALL MAMMALS
1. eastern chipmunk—seeds and fruits
2. eastern gray squirrel—buds, seeds, fruits and fungi
3. southern flying squirrel—seeds, fruits, buds and insects
4. white-footed mouse—seeds, buds, fruits and insects
5. pine vole—the roots of plants
6. short-tailed shrew—earthworms, snails and insects
7. silver-haired bat—insects

MEDIUM-SIZED MAMMALS
8. raccoon—fruits, seeds, insects, snails, earthworms, amphibians, reptiles, fish, and small mammals and birds

LARGE MAMMALS
9. gray fox—fruits, seeds, small mammals and birds and insects
10. bobcat—small mammals, birds and insects
11. white-tailed deer—the flowers, bark, buds, fruits and seeds of plants

SMALL BIRDS
12. rufous-sided towhee—seeds, fruits and insects
13. acadian flycatcher—insects, fruits and seeds
14. yellow-billed cuckoo—insects, especially caterpillars, also fruits and seeds
15. black-capped chickadee—insects, fruits and seeds
16. red-headed woodpecker—insects, especially ants; also fruits and seeds
17. whip-poor-will—insects
18. hooded warbler—insects, especially beetles, ants and caterpillars
19. yellow-throated vireo—insects and spiders
20. orchard oriole—insects, especially caterpillars, also fruits
21. fox sparrow—insects, especially beetles; also fruits and seeds

LARGE BIRDS OF PREY
22. barred owl—small birds and mammals, reptiles, amphibians, fishes and insects
23. eastern screech owl—small birds and mammals, reptiles, amphibians, and insects
24. great horned owl—all types of animals except the largest mammals and large birds of prey.
25. red-shouldered hawk—small birds and mammals, reptiles, amphibians and insects
26. Cooper's hawk—small birds and mammals, reptiles, amphibians, and insects

AMPHIBIANS
27. marbled salamander—snails, worms, insects and spiders
28. eastern gray tree frog—insects
29. eastern wood frog—snails

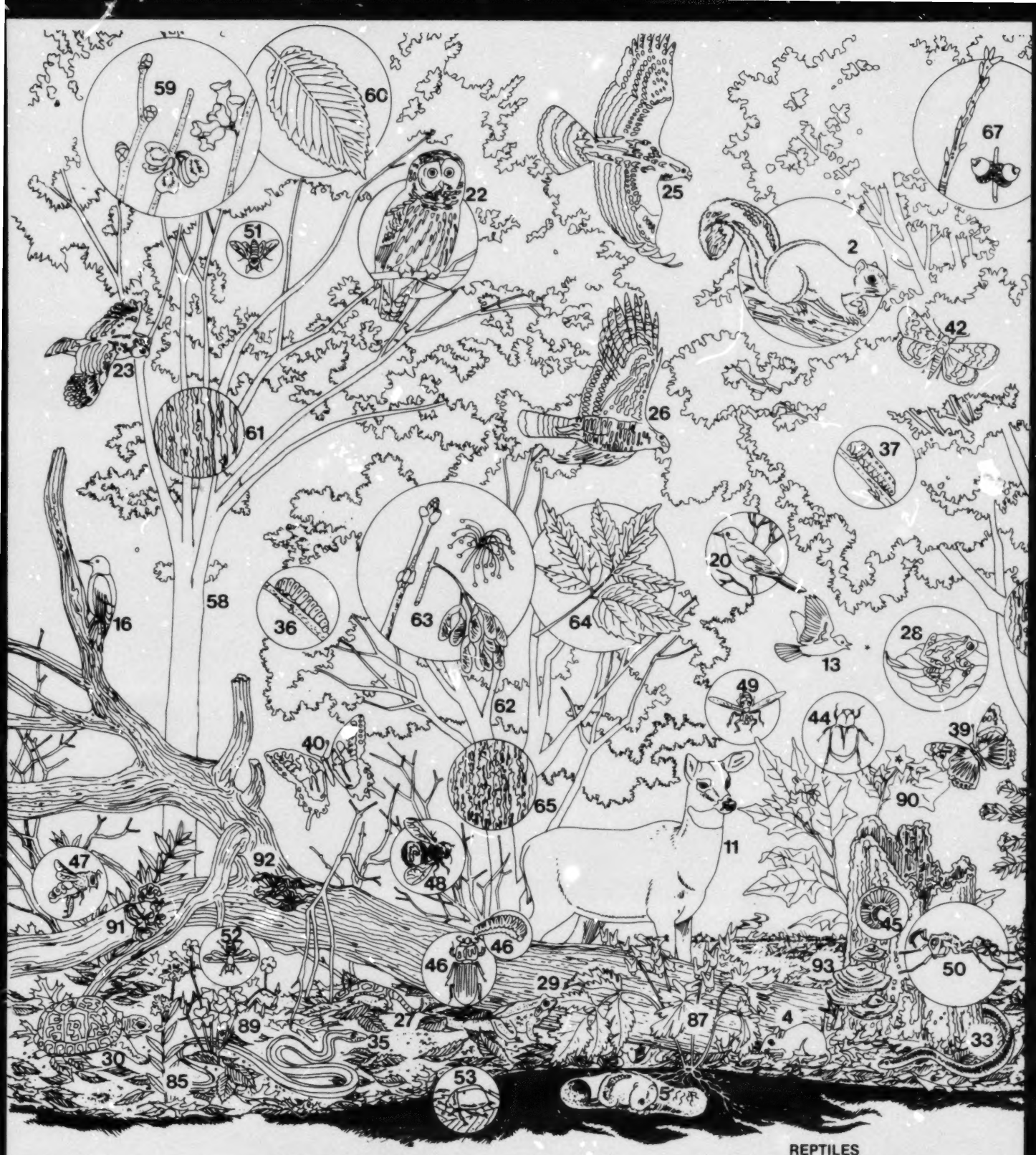
REPTILES
30. eastern box turtle—fungi, fruits, seeds, insects, snails and spiders
31. northern fence lizard—insects, especially ants
32. ground skink—insect larvae
33. blue racer—small mammals and birds, amphibians, reptiles and insects
34. speckled kingsnake—small birds and mammals, small snakes and insects
35. eastern garter snake—amphibians, earthworms, and young birds

INSECTS
36. zebra swallowtail caterpillar—leaves of trees
37. tiger swallowtail caterpillar—leaves of trees
38. viceroy caterpillar—leaves of trees
39. red admiral butterfly—the nectar of flowers
40. tiger swallowtail butterfly—the nectar of flowers
41. imperial moth caterpillar—leaves of trees
42. underwing moth—leaves of trees
43. searcher beetle—caterpillars
44. hermit flower beetle—the pollen held in flowers
45. hermit flower beetle larvae—decaying wood
46. horned passalus beetle (adult and larvae)—decaying wood
47. honey bee—pollen and nectar from flowers
48. bumble bee—pollen held in flowers
49. small carpenter bee—pollen held in flowers
50. black carpentar ants—insects
51. elm sawfly—the leaves of trees
52. flowerfly—pollen held in flowers
53. carrion beetle—dead plant and animal matter

SPIDERS
54. triangle spider—small insects

WORMS (ANNELIDS)
55. earthworm—dead plant and animal materials in the soil

SNAILS (MOLLUSKS)
56. white-lipped land snail—dead plant material
57. land snail—leaves of plants



SMALL MAMMALS
1. eastern chipmunk
2. eastern gray squirrel
3. southern flying squirrel
4. white-footed mouse
5. pine vole
6. short-tailed shrew
7. silver-haired bat

MEDIUM-SIZED MAMMALS
8. raccoon

LARGE MAMMALS
9. gray fox
10. bobcat
11. white-tailed deer

SMALL BIRDS
12. rufous-sided towhee
13. acadian flycatcher
14. yellow-billed cuckoo
15. black-capped chickadee
16. red-headed woodpecker
17. whip-poor-will
18. hooded warbler
19. yellow-throated vireo
20. orchard oriole
21. fox sparrow

LARGE BIRDS OF PREY
22. barred owl
23. eastern screech owl
24. great horned owl
25. red-shouldered hawk
26. Cooper's hawk

AMPHIBIANS
27. marbled salamander
28. eastern gray tree frog
29. eastern wood frog

REPTILES
30. eastern box turtle
31. northern fence lizard
32. ground skink
33. blue racer
34. speckled kingsnake
35. eastern garter snake

INSECTS
36. zebra swallowtail caterpillar
37. tiger swallowtail caterpillar
38. viceroy caterpiliar
39. red admiral butterfly
40. tiger swallowtail butterfly
41. imperial moth caterpillar

42. underwing moth
43. searcher beetle
44. hermit flower beetle
45. hermit flower beetle larvae
46. horned passalus beetle (adult and larvae)
47. honey bee
48. bumble bee
49. small carpenter bee
50. black carpentar ants
51. elm sawfly
52. flowerfly
53. carrion beetle

SPIDERS
54. triangle spider

WORMS (ANNELIDS)
55. earthworm

SNAILS (MOLLUSKS)
56. white-lipped land snail
57. land snail

PLANTS
58. slippery elm tree
59. slippery elm buds, fruit and flower
60. slippery elm leaf
61. slippery elm bark
62. box elder tree
63. box elder twig, fruit, and flower
64. box elder leaf
65. box elder bark
66. red oak tree
67. red oak buds and fruit
68. red oak leaf
69. red oak bark
70. hackberry tree
71. hackberry buds, fruit and flower
72. hackberry leaf
73. hackberry bark
74. river birch tree
75. river birch buds, flower and fruit
76. river birch leaf
77. river birch bark
78. smooth sumac tree
79. smooth sumac buds and fruit
80. smooth sumac leaf
81. smooth sumac bark
82. rough-leaved dogwood shrub
83. rough-leaved dogwood flower
84. rough-leaved dogwood fruit and leaf
85. wild forget-me-not
86. starry false solomon-seal
87. dutchman's britches
88. wild strawberry
89. yellow wood sorrel
90. horse nettle
91. ear fungus
92. oyster mushroom
93. artist's fungus
94. hen of the woods

Plant Reproduction in the Forest

To understand how trees and other plants pass on life from one generation to another, study the five stages of the reproduction cycle of plants and complete the *Thinking Further* section.

1. FLOWERING

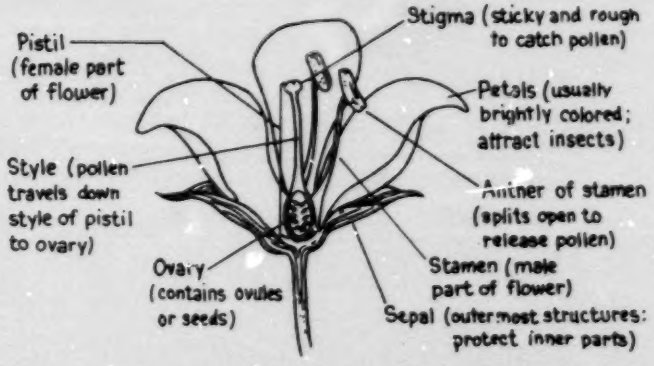
Usually in the spring of the year, plants bear flowers. A complete flower is composed of four main parts, sepals, petals, pistil and stamen. The *sepals* are the outermost circle of leaves which protect the inner parts of the flower. The *petals*, stationed inside the sepals, may be brightly colored. The *pistil* is found in the center and is the female part of the flower. A stigma, shaped like a small bulb is at the top of the pistil. A slender stalk called the style runs from the stigma to the base of the pistil where the ovary is stationed. The ovary contains the undeveloped ovules (or seeds) of the flower. The *stamen* is the male part of the flower. At the top of the stamen is the anther. The anther is packed with pollen.

It is important to understand that the flowers of different species are not alike. Some flowers have both a stamen and a pistil. Some flowers have just one or the other. A flower that has only a stamen is called a staminate or male flower. A flower that has only a pistil is called a pistillate or female flower. Not only are flowers different, so are plants. Some species of plants have both pistillate and staminate flowers on the same plant. Some species have pistillate flowers on certain plants and staminate flowers on others. Of course, flowers differ greatly in size, shape, color and how they are displayed.

2. POLLINATION AND FERTILIZATION

Pollination is defined as the transfer of pollen from the stamen to the pistil. Pollen can be carried in this way by wind or by insects. Flowers that depend on insects to carry their pollen have bright, showy flowers and/or nectar to entice the insects to them. When an insect visits such a flower, chances are good the sticky, moist pollen put out by the anther of the stamen will rub off onto the insect. When that same insect visits the pistil of the same or different flower, the pollen is rubbed off the insect onto the sticky, rough surface of the stigma, which functions sort of like a catcher's mitt for the pistil. Wind pollination is somewhat less complicated. The stamen and anthers of wind-pollinated plants are large and send out sizable amounts of dry, light pollen which catches the breeze and rides to the awaiting stigma on pistillate flowers. But what does pollination accomplish in the reproductive cycle?

Once pollen is caught by the stigma, it travels down the style to the ovary where it causes the ovules (seeds) to become fertilized. That is defined as the process of *fertilization*. Stop for a moment and study the illustration below to make sure you understand stages 1 and 2.


Pistil (female part of flower)
Stigma (sticky and rough to catch pollen)
Petals (usually brightly colored; attract insects)
Style (pollen travels down style of pistil to ovary)
Anther of stamen (splits open to release pollen)
Ovary (contains ovules or seeds)
Stamen (male part of flower)
Sepal (outermost structures; protect inner parts)

3. FRUITS AND SEEDS:

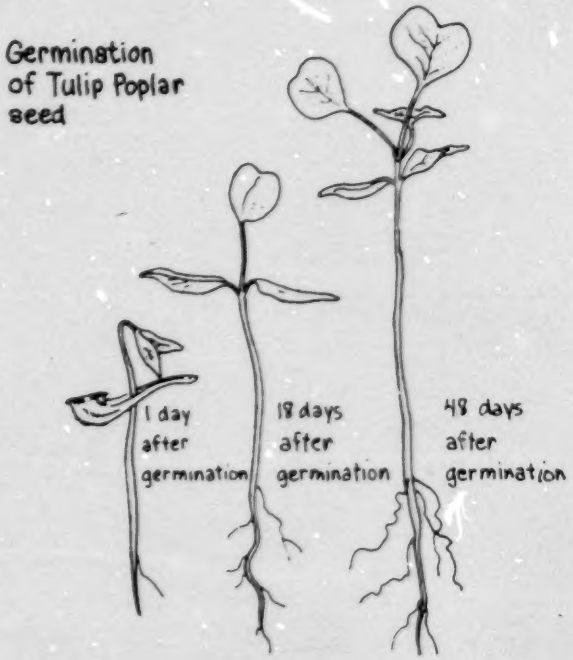
Following fertilization, the ovary and the ovules (seeds) begin to grow. The ovary grows into a fruit and the ovules develop into mature seeds. The fruit (which varies in shape, size, color and texture in different plants) will serve as a carrying case or vessel for the journey of the seeds to the soil.

4. SEED MOVEMENT:

How do seeds travel from parent plants to the soil where they can eventually grow as a new plant? Some seeds fall to the ground inside their fruits and are either eaten by animals, left to rot, or carried away by water. Other seeds are carried by the wind while still others stick to the fur of animals and the clothing of man. For a more detailed investigation into how seeds travel, complete the exercise on page 18 of this booklet.

5. GERMINATION:

Most seeds do not immediately start to grow the minute they hit the soil. Instead, they lay in rest (dormancy) for a period of time. At the end of this rest period, the seed takes in water and starts to grow rapidly. The seed coat pops open and a root runs downward into the soil while a shoot pushes upward to catch the sunlight. This process is known as *germination* and completes the reproduction cycle.

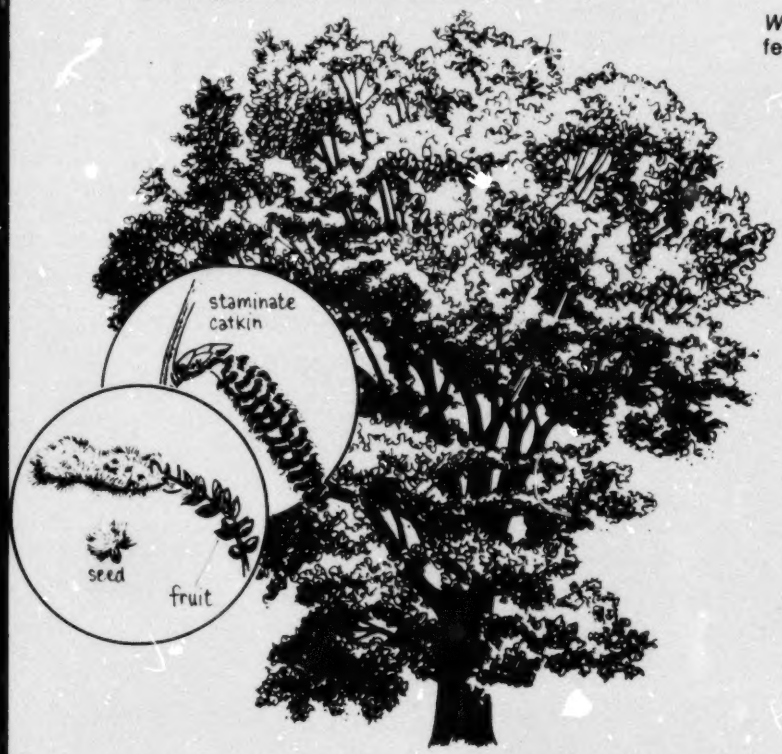


THINKING FURTHER

1. Name and describe the four main parts of a flower.
2. Define the term pollination.
3. Pollen can be carried by two things. Name them.
4. Explain the process of fertilization.
5. Following fertilization, the ovary and the ovules (seeds) begin to grow. The ovary grows into a _____ and the ovules develop into mature _____.
6. Name two ways seeds move from their parent plants to the soil where they may someday grow as new plants.
7. Explain the process known as germination.

FITTING TOGETHER PLANT REPRODUCTION CYCLES:

In the previous exercise, "Plant Reproduction in the Forest", you studied the five stages in the reproduction cycle of plants. It is your assignment in this exercise to fit together the reproduction cycles of three forests plants, cottonwood, white ash and spring beauty. To do that, begin with the section on cottonwood. There are five sentences describing the reproduction cycle of cottonwood. Each of those sentences describes one of the stages in the reproduction of plants. To refresh your memory, those stages in the proper order are (1) Flowering (2) Pollination and Fertilization (3) Fruits and Seeds (4) Seed Movement (5) Germination. However, the five sentences in the cottonwood section are scrambled and not in the proper order. It is your job to unscramble the sentences and put them in the proper order. To help you out, one of the sentences has already been numbered as to its proper order. After you have placed the sentences in the proper order, you will have fit together the reproduction cycle of cottonwood. To fit together the reproduction cycles of white ash, and spring beauty, follow the same instructions.



COTTONWOOD Cottonwood is a large tree growing up to 100 feet tall.

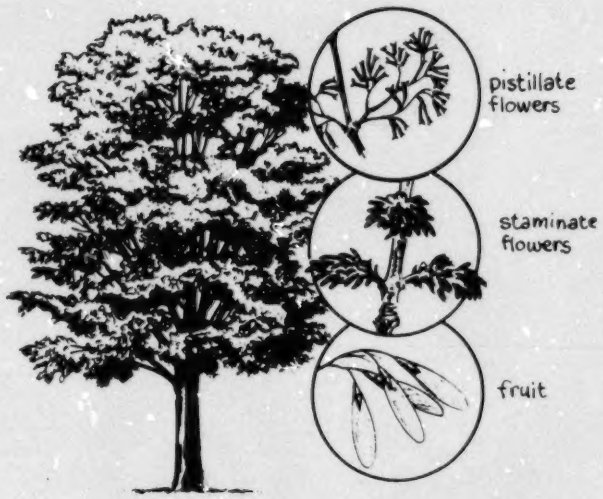
The staminate and pistillate flowers of cottonwood are born separately on different trees; the staminate flowers are thick reddish catkins and the pistillate flowers are narrower, greenish yellow catkins.

3. By May, the pistillate flowers have matured into long strings of greenish brown capsule fruits which hold tiny seeds.

   Wind carries pollen from the staminate flowers to the pistillate flowers where the seeds are fertilized.

   The seeds of the cottonwood must arrive at moist soil along a river or stream bank within a few hours after leaving the tree or they lose their ability to germinate.

   During spring and summer, the fruits split open and the seeds (which have a cottony, white sail attached to them) catch the wind and travel from the parent trees.



WHITE ASH White ash is also a large tree growing up to 100 feet tall.

The seed of white ash may lay dormant until the next spring and then germinate or the seed may lay dormant for several years before it germinates.

2. Shortly after the flowers appear, wind carries pollen from the staminate flowers to the pistillate flowers where the seeds are fertilized.

   The staminate and pistillate flowers of white ash are born separately on different trees, appear in Spring before the leaves unfold, and are small, purplish and grouped in clusters.

   By midsummer, the pistillate flowers have ripened into light brown, paddle-shaped fruits which each hold a single seed.

   The fruits of white ash have a narrow, light wind which travel by catching the wind when the fruits fall from the trees in late summer or fall.

SPRING BEAUTY Spring beauty is a very common woodland wildflower that grows to be about 6 inches tall.

The seeds of spring beauty lay dormant in the soil through the summer, fall and winter and germinate the following spring.

By May, each capsule fruit of spring beauty has matured and holds three to six flat seeds.

The white or pinkish flowers of spring beauty bloom by the first week in March; each flower has both a stamen and a pistil.

4. When the fruits are very ripe, they split open and the seeds fall to the soil.

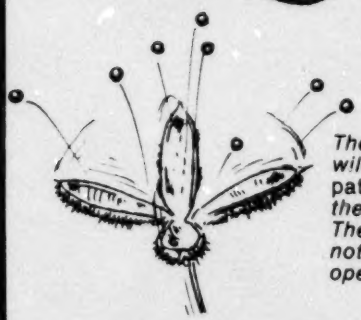
   Shortly after the flowers bloom, insects, especially bees, carry pollen from one flower to another where the seeds are fertilized.

How Seeds Move in the Forest

The forest never stands still. Even in the fall when the trees are losing their leaves and the birds have stopped singing, parts of the forest are on the move. Seeds, especially, are traveling from parent plants to new locations where they may someday grow into plants. On the previous page, you learned a seed ripens inside the fruit of a plant. In some cases, the fruit matures, splits open and releases its seed. When that happens, the seed has to do its own traveling. In other cases, the fruit leaves the plant by one way or another and it carries the seed with it. When that happens, the fruit is a carrying case for the seed. In either case, the structure of a fruit and its seed determines how the seed will travel through the forest. Below is a chart listing nine different types of fruits and seeds and the nine different ways each is moved through the forest. Study the list and then examine the nine fruits and seeds drawn below the chart. After you have carefully looked at the make-up of the fruits and seeds and studied the description belonging to each, write down *how* you think each of the nine fruits and seeds is moved from its parent plant to a new location in the forest.

1. Winged fruits—carried by wind.
2. Fruits with plumes (cottony, feathery, fibers attached to fruit)—carried by wind.
3. Fruits with spines or barbs (fruits that have spines or barbs that catch in the fur of animals or the clothes of people)—carried by animals, including humans.
4. Corky fruits (fruits that have air spaces enabling them to float)—carried by water.
5. Tiny seeds—carried by wind
6. Tiny seeds with arils (minute seeds that are so small they can be carried by insects. These seeds have arils, an extra bit of tissue which insects like to eat. For example, ants often carry seeds a long distance before they eat the aril and leave the seed.)—carried by insects.
7. Fleshy fruits (berries, pomes, drupes) eaten by animals and passed out in feces; or left to rot and seeds enter the soil.
8. Nuts—buried in ground by squirrels and other animals.
9. Explosive fruits—fruits burst open and the seeds shoot out.

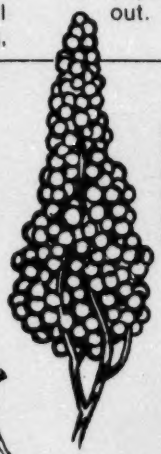
The fruit of swamp white oak is an acorn. Acorns are borne in pairs and serve as a nut food for animals.



The scientific name of the wildflower touch-me-not is Impatiens pallida, (Impatiens *is the Latin word for impatient). The mature fruit of touch-me-not is so impatient, it bursts open at the slightest touch.*

The capsule fruit of yellow trout lily splits open to spill many tiny seeds. The seeds have an aril which insects are fond of eating.

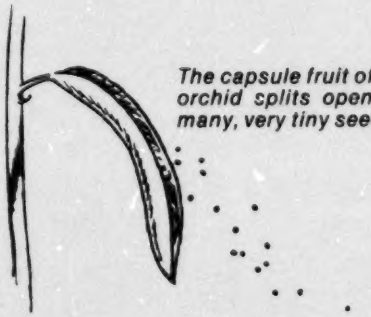
The fruit of tick-trefoil is a legume (a bean-like fruit bearing a seed pod). Each legume carries about 3 seeds and is covered with very sticky, hooked hairs.



The juicy red berries of smooth sumac each contain a single brown seed. The berries hang on the tree well into winter and are eaten by animals that can either climb or fly.

The narrow capsule fruits of quaking aspen are grouped in clusters. The many small seeds held in each fruit have cottony hairs attached to them.

The round, light, ball-like fruit of sycamore can float for quite a while. Each fruit contains many small seeds which need damp soil for germination.



The capsule fruit of tway-blade orchid splits open to release many, very tiny seeds.

The fruits of black maple each bear one seed, are borne in pairs and have thin, light wings.

Forest Shelters

Below are eight animals and eight shelters found in a forest ecosystem. A shelter is any place or thing that protects an animal or its young from harsh weather and/or attack from other animals. Study the shelter requirements of the eight animals below. Then match each animal to the shelter it needs by drawing a line from the animal to the shelter.

Burying Beetle

The burying beetle uses the soil of the forest as shelter and as a way of preserving its food. When a small mammal or bird dies, it buries the body by digging away at the soil from below. The female beetle then lays her eggs near the buried food and when the young grubs hatch, there is a ready supply of food.

Luna Caterpillar

The luna caterpillar makes its own shelter using silk produced by a gland near its upper lip. Hanging from a twig, the caterpillar spits out silk while shaking its head back and forth in a zig-zag motion. In a short time, the caterpillar spins a tough, water-proof, two-layered case of silk that is firmly tied to the twig. In this cocoon, the caterpillar (now known as a pupa) will undergo metamorphosis or changes in its physical make-up. The pupa spends the winter in the cocoon and in May or June, breaks out of the cocoon as a luna moth.

Silver-haired Bat

The silver-haired bat commonly takes shelter beneath the loose bark of trees. In such a shelter, the young bats (usually two) cling to the body of the female bat until they are about 3 weeks old and ready to fly by themselves.

Gray Fox

The gray fox commonly makes its den in the base of a hollow tree. During spring and summer, three to five naked and nearly blind kits are born in the den. During the rest of the year, the gray fox uses its den as a hidden resting place, usually during daylight hours.

Hairy Woodpecker

It takes 1-3 weeks for a pair of hairy woodpeckers to chisel out a nest cavity in the side of a tree. If the tree is dead or has rotten heartwood, the work takes less time. The opening of the cavity may be 1-1½ inches wide but the cavity itself may be as deep as 15 inches. Sometimes the male hairy digs a shallower hole near the nesting tree as a sleeping spot.

Northern Oriole

The female northern oriole builds a swinging nest high in a tree. First she hangs long strands of dried plant stalks, yarn or hair over the twigs of a tree. Next, she loops and weaves the strands together into a strong basket. Hanging on the nest, often with her head down, she chatters or sings a bit as she weaves.

Northern Fence Lizard

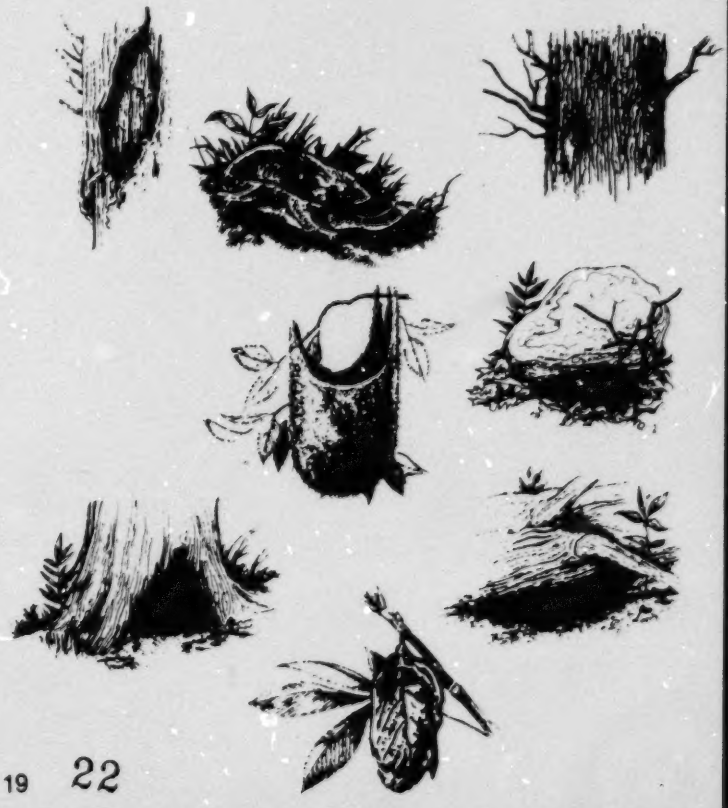
When not basking in the sun, the northern fence lizard commonly seeks shelter under fallen and decaying logs. Such a log is often used by the female lizard in summer as a place to deposit her long, soft-shelled eggs.

Blue Racer

The blue racer is often found under a rock, especially when it is time to shed its skin or when the weather is cold. In early summer, 19 to 15 white eggs are laid under a rock by the female racer.

Thinking Further

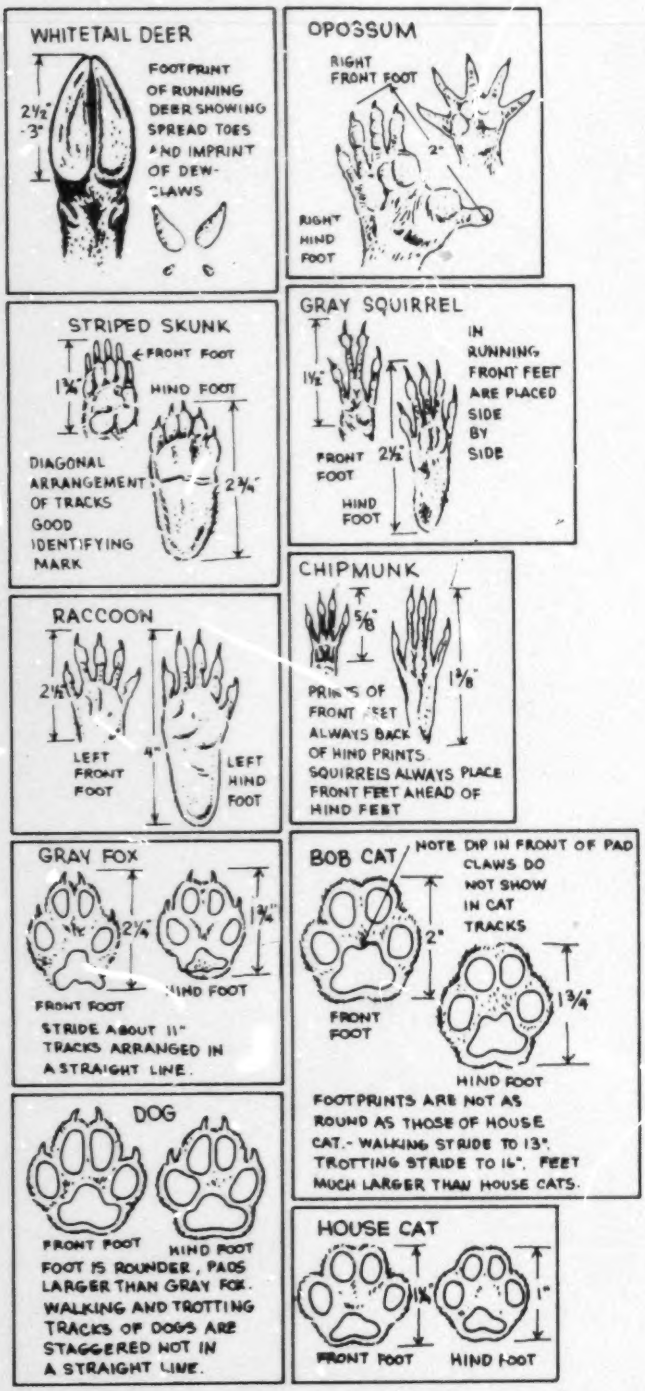
The tallest branches of the forest (the canopy) form a protective cover over the forest ecosystem. The canopy provides shade and shields plants and animals from strong winds and rain. The roots of trees and plants hold the soil steady, benefitting the plants that must grow from the soil and the animals that must take shelter in the soil. In your own words, explain how the forest ecosystem is one big shelter protecting many smaller shelters.



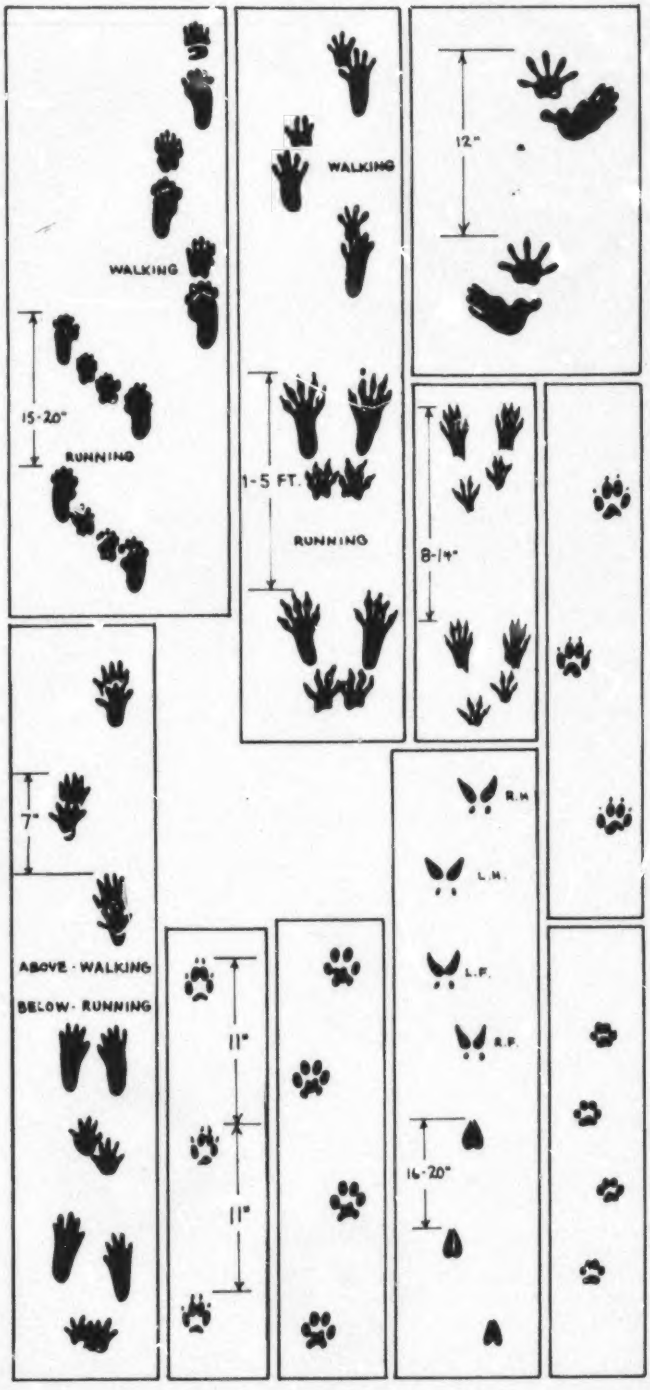
Tracking the Mammals of the Forest

Secretive and weary, the mammals of the forest are not easily seen. One of the best ways to tell if a mammal has been around is to find its tracks. Drawn for you below on the left are the feet of ten mammals. On the right, ten sets of tracks (some showing both running and walking gaits) are drawn just as they appear when they are imprinted on the forest floor. It is your assignment to carefully study the feet of each mammal and then match each mammal to the set of tracks you think its feet would make. After you are through, your work will be a guide to the mammal tracks of the forest. In fact, you can use your work to complete Strategy G at *Location One* of *FOREST SLEUTHWORK*. *Special Note:* The house cat and dog are not native mammals of the forest; however, they are included in this exercise so that you will be able to tell their tracks from native mammals as you go forest tracking.

MAMMALS



TRACKS



23

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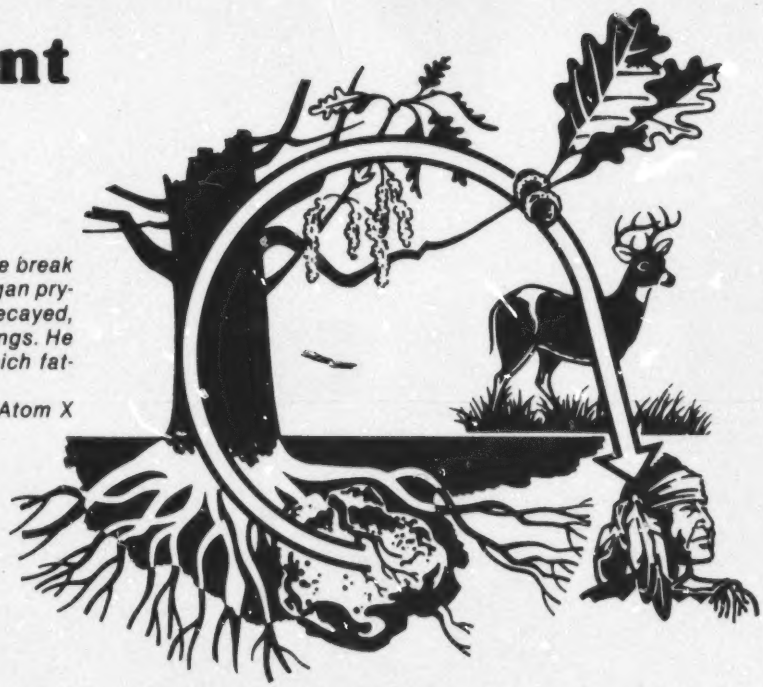
Nutrient Element Cycling



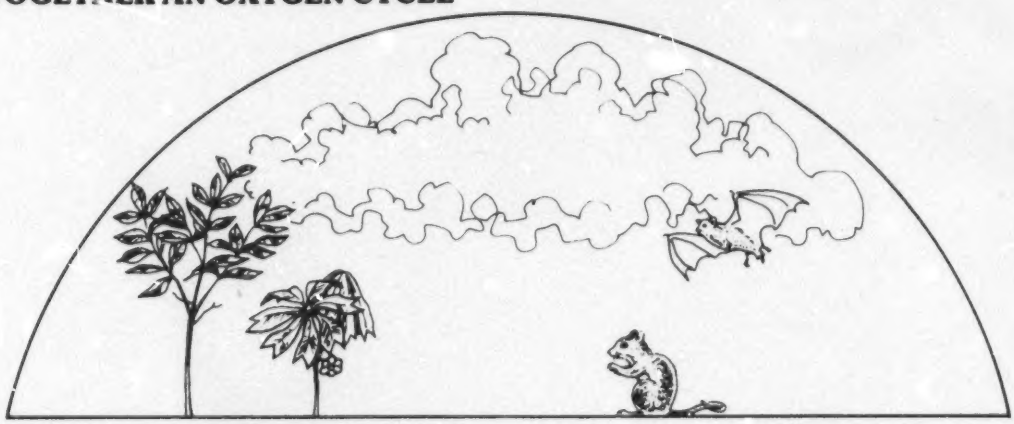
"Time, to an atom locked in a rock, does not pass. The break came when a bur oak root nosed down a crack and began prying and sucking. In the flash of a century, the rock decayed, and X was pulled out and up into the world of living things. He helped to build a flower, which became an acorn, which fattened a deer, which fed an Indian, all in a single year."

Aldo Leopold, "Odyssey" of Atom X

Aldo Leopold, oftentimes called the grandfather of conservation, is describing the path of Atom X through a forest ecosystem. Although there are few Indians still living in Illinois, people continue to have a place in forest ecosystems. In Leopold's passage, Atom X travels from a rock to the soil, up the roots of a bur oak tree, and into its flower. Atom X is used to help ripen the flower into an acorn; the acorn is eaten by a deer who in turn is eaten by an Indian. What is Atom X and where will it go from the Indian?

Atom X is part of an element. Elements are the basic units of matter from which all things on earth are made. Living organisms need 30-40 elements for normal growth. The most important elements are carbon, hydrogen, oxygen, nitrogen, sulfur and phosphorus. *Because these elements help plants and animals grow, they are known as nutrient elements and since there is a limited supply of nutrient elements they must be recycled so plants and animals can use them over and over again.* Atom X will be recycled after it leaves the Indian. Fit together some of the nutrient cycles of the forest (oxygen, water, and carbon) and then you will be able to state how.

FITTING TOGETHER AN OXYGEN CYCLE



(Oxygen is vital to the development of all living things. 21% of the atmosphere is composed of oxygen).

The forest scene above has all of the parts necessary to illustrate the oxygen cycle on land. It is your job to match the parts of the forest scene to the explanations of the oxygen cycle listed on the next page. Here is a strategy for doing just that. *Step 1.* Read the first explanation (A) and put the letter (A) beside the part of the forest scene explanation (A) is describing. For example, is explanation (A) describing the role of the tree, the mammal or the air mass of the forest? After you decide, read all of the explanations and place the letter of each explanation (A, B, or C) beside the part of the forest scene it describes. *Step 2.* Now you are ready to label the parts of the forest with common names. For example, what is the common name for the tree on the left? *Step 3.* It is now time to fit the whole cycle together. Start at the first explanation (the atmosphere) and reread all of the explanations. Notice that each time oxygen is transferred from one part of the forest scene to another, the sentence describing that movement is underlined. Each time you see an underlined sentence, draw an arrow from the part of the cycle oxygen is leaving to the part it is arriving at. Remember, every part of the forest that takes in oxygen also releases it back into the atmosphere. That is how oxygen is recycled.

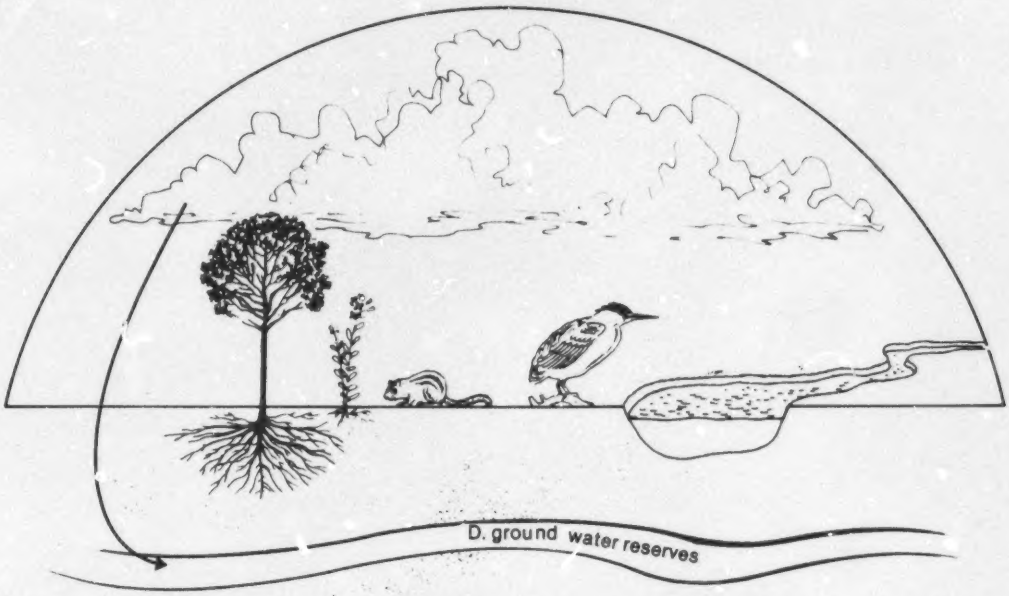
EXPLANATIONS

A In the forest scene on the previous page, the air or atmosphere serves as the holding tank for oxygen.

B *Green plants, such as the paw paw, a small tree with a broad crown, and the mayapple, a large wildflower, take in oxygen from the atmosphere and use it in the process of respiration. Green plants such as the paw paw and mayapple release oxygen back into the atmosphere as they conduct photosynthesis.* In fact, green plants are responsible for manufacturing most of the oxygen in the atmosphere.

C *Animals such as the silver-haired bat, a dark, small bat up to 4½ inches long, and the white-footed mouse, a brown mouse with white undersides and feet, also take in oxygen from the atmosphere. Yet, as they respire, they release oxygen back into the atmosphere.*

FITTING TOGETHER A WATER CYCLE



(Water is the source of the element hydrogen.
Water also carries the other nutrient elements through the forest ecosystem).

The forest scene drawn above has all the parts necessary to illustrate the water cycle of the forest. To fit together the water cycle, use the same directions you followed to put together the oxygen cycle. To help you out a bit, some of the work has been done for you. Remember, each time you see an underlined sentence, water is moving from one part of the water cycle to another. You should show that movement by drawing an arrow from the part water is leaving to the part it is arriving at.

EXPLANATIONS

A *Water is stored in clouds in the atmosphere. From those clouds, water falls as rain to the soil of the forest.*

B *Water in the soil is absorbed through the roots of plants such as hop hornbeam, a small tree up to 35 feet tall, and bulbous cress, a wildflower up to 18 inches tall.* The water carries into plants all of the nutrients they need for development. *The plants use water during photosynthesis and release water back into the atmosphere during respiration.*

C *Some of the rainfall from the atmosphere runs into streams which feed lakes, rivers and eventually the ocean. During the process of evaporation, water in the form of water vapor returns to the atmosphere from those bodies of water.*

D *Some of the rainfall from the atmosphere penetrates through the soil of the forest to deep ground water reserves.* These reserves feed springs, seeps and lakes.

E *Some of the rainfall from the atmosphere hits the soil and returns to the atmosphere almost immediately during the process of evaporation.*

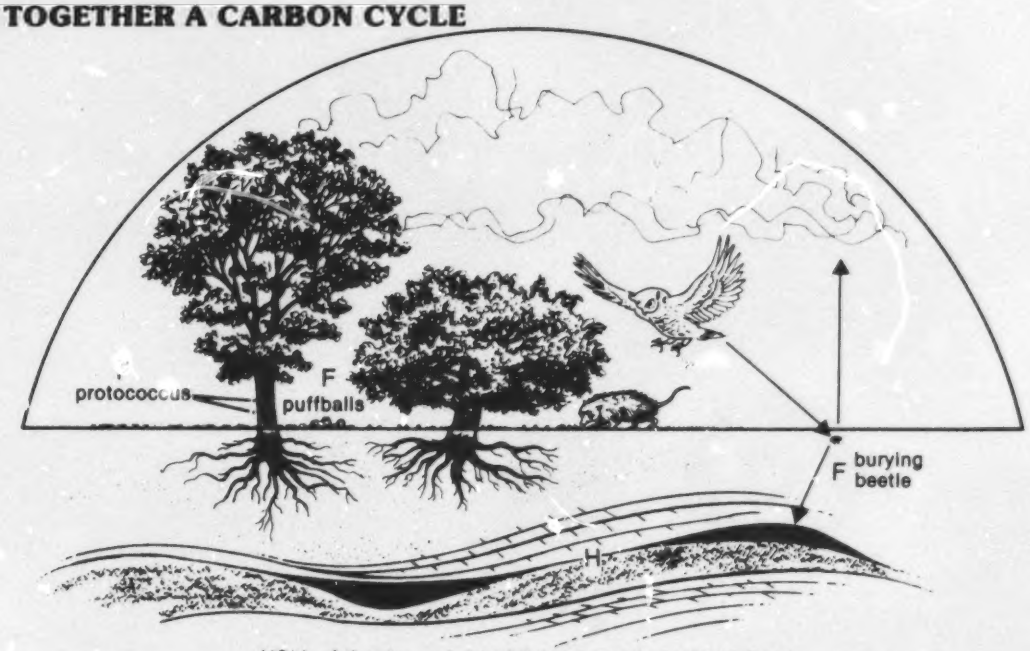
F Animals take in water either from bodies of water or by eating plant tissues, fruits or seeds. *In this scene, an eastern chipmunk, a small mammal, is eating the flat smooth fruit of bulbous cress and a green heron, a bluish-green colored bird, is drinking water from the stream. When animals, such as the eastern chipmunk and the green heron respire, water is returned in the form of water vapor from their bodies to the atmosphere.*

THINKING FURTHER:

1. A great deal of oxygen is taken out of the atmosphere when fossil fuels such as coal, oil and gas are burned to energize homes and industries. We depend on green plants conducting photosynthesis to restore the oxygen supply in the atmosphere. Can the removal of large areas of trees and other plants affect the production of oxygen? If yes, explain how? What does your answer mean for people, for plants, for animals?

2. Trees and other plants are very important in the water cycle. They return water vapor to the atmosphere as they undergo respiration. The roots of trees and other plants hold the soil and prevent the soil from washing away into streams, lakes and rivers. Explain how the water cycle is affected when forests are entirely stripped of trees and other plants.

FITTING TOGETHER A CARBON CYCLE



(49% of the dry weight of living organisms is carbon)

The forest scene drawn above has all of the parts necessary to illustrate the carbon cycle on land. To get together the carbon cycle, use the same instructions you followed to fit together the oxygen and water cycles.

EXPLANATIONS

A The atmosphere of the earth stores carbon in the form of carbon dioxide. (CO_2).

B *The pecan, a large tree up to 150 feet tall, is taking in carbon dioxide from the atmosphere through its leaves.* In those leaves, carbon dioxide is used in the process of photosynthesis. *When the pecan respires, carbon dioxide and water vapor are released as waste products into the atmosphere through its leaves and into the soil through its roots.*

C *The leaves of Red Mulberry, a medium tree up to 50 ft. tall, also take in carbon dioxide from the atmosphere to use in photosynthesis. And like the pecan, the red mulberry releases carbon dioxide to the atmosphere when it respires.* The red, juicy berries of red mulberry are eaten by many animals. In this scene, an opposum is feasting on the berries. *This means carbon compounds are being transferred from the red mulberry to the opposum.*

D The opposum, like all animals, also respires in order to release energy inside the cells of its body. *As it respires, carbon dioxide is released to the atmosphere.* The opossum is eaten by foxes, coyotes, large owls and maybe minks. In this scene, the opossum is about to be killed and eaten by a great horned owl. *After that occurs, carbon compounds will transfer from the opossum to the great horned owl.*

E Just like the pecan, the red mulberry and the opossum, the great horned owl respires to gain the use of energy stored in its body. *As it does so, carbon dioxide is sent out into the atmosphere.*

F In this forest scene, there are three decomposers. The protococcus is a bacteria growing on the bark of the pecan tree. *The protococcus is feeding on the tissues of the tree and carbon compounds are moving from the pecan to the protococcus. The puffballs, small pear-shaped fungi, are feeding on the fallen leaves and limbs of the pecan and red mulberry and carbon compounds are moving from the leaves and limbs to the puffballs.* The burying beetle is an insect living in the soil. *When the great horned owl dies, the burying beetle will feed on its body, and carbon compounds will be transferred from the owl's body to the beetle.* As one can see, the decomposers play a very important role in the carbon cycle of the forest because they receive carbon from every organism by one way or another. *Furthermore, when the decomposers undergo respiration, they release more carbon dioxide back into the atmosphere than do larger plants and animals.*

G *When the decomposers die and decay into the soil, carbon compounds will be transferred to the soil.* Remember that the roots of the pecan and red mulberry are already releasing carbon dioxide into the soil. *Some of the carbon dioxide is released from the soil to the atmosphere but most of it goes in the opposite direction, downward.*

H After many thousands of years, bits of animals and plants in the soil form reserves of peat, coal, oil and carbonate rocks deep below the ground surface. *These reserves store the majority of the earth's total carbon.*

THINKING FURTHER:

1. The forests of the world take in more carbon dioxide from the atmosphere than any other ecosystem. Approximately 15 billion tons of carbon dioxide are taken out of the atmosphere by trees which use the carbon to build their woody tissues. This transformation of carbon dioxide to wood is very important because it helps prevent a build-up of carbon dioxide in the atmosphere. Such a build-up is a real danger as we continue to burn larger and larger amounts of coal, oil and natural gas (fossil fuels which release carbon dioxide into the atmosphere). In the past century, the amount of carbon dioxide put into the atmosphere by the burning of fossil fuels has increased by 2.3 parts per million each year. In your own words, explain how forests help control the amount of carbon dioxide in the atmosphere?

The Family Tree

(a play)

List of Characters:

Gray Squirrel	Water	Wood Duck
Bobcat	Capillary Action	Insects
Acorn	Transpiration	Red-headed Woodpecker
Spring	50 year old tree	125 year old tree
25 year old tree	Fungi	Autumn
Xylem tissues	75 year old tree	155 year old tree
Chorophyll	Cambium tissues	Winter
Carbon dioxide	Heartwood	Pollen
Photosynthesis	Sapwood	Summer
Auxin	100 year old tree	Thunderstorm
Phloem tissues	Cavities	225 year old tree
Bark	Screech Owl	Death

Setting:

In one area of Brown County, Illinois, there is rolling forest of hickory, oak and ash. The north side of the forest slopes down to a small meadow and a pond. On the side of the pond facing the forest there is a large stump of a white oak tree. On that stump, a gray squirrel is cracking the cap off an acorn. Fifty yards away at the edge of the forest, a bobcat is watching the squirrel with great interest.

The Play Begins

GRAY SQUIRREL: It was my great, great, great (oh, I guess it's too many greats to mention) grandfather who, near this very spot, found an especially fine and large acorn back in the late summer of 1751. Knowing that this kernel of food would come in handy on a cold, wintry day, he carefully gnawed the cap off the acorn and with his front feet, dug a hole in the ground about 1½ inches deep. He dropped the nut in the hole and covered it with dirt. He then raked leaves and twigs over the tiny mound. The job of storing the nut done, my many times great grandfather climbed to the top of the nearest tree and by leaping from limb to limb, tree to tree, made his way from the little pond into the deep forest.

BOBCAT: Very, very, quietly, my many times great grandmother tip-toed through the forest watching and listening to the squirrel traveling in the tree tops above her. Each time the squirrel took a leap he did so with great skill, carefully twisting his body to miss hitting snags along the way. "Fat chance of eating that squirrel for dinner", sighed my grandmother. But just as she was about to strike out on a different path through the forest, she noticed that the squirrel had come to the outermost limb of one tree and that the nearest limb of another tree was a good 15 feet away. To make the jump, the squirrel would have to make a daring downward dive. My many times great grandmother stood still and held her breath. The squirrel launched his leap and down he swooped. With all his might he stretched his body to go that extra inch but it wasn't enough. Realizing he was going to fall short of his destination, he swung his landing gear down and hit the ground on his hind feet. SWASH! With one sweep of my grandmother's paw, the squirrel was dead.

ACORN: Hey, in all the excitement, don't forget me. I'm really the star of the whole story. Shortly after the squirrel buried me in the earth beside the little pond, I germinated. Tiny roots erupted through my skin and took hold in the soil. But when winter came, my growth slowed to a bare idle. Above me, a fierce Illinois winter was at work, dumping many inches of snow and freezing rain on the ground. Even the bravest animals were disappointed in their attempts to find me.

SPRING: It was I who broke the back of winter, bringing warm breezes and gentle rains. Under my care, the little acorn began to grow quickly.

ACORN: Yes, my roots shot out like lightning in all directions and took a mighty grip in the soil. In the opposite direction, my tiny shoot pushed up through the ground surface and lifted its face to the sun.

25 YEAR OLD TREE: The first years of my life passed smoothly and I had twenty five thick rings of xylem to show for it.

XYLEM TISSUES: I was the wood beneath the outer layers of the tree. Each day during the growing season, with the help of sunshine, the tree piped minerals and water from the soil through my heavily walled tissues to the leaves.

CHLOROPHYLL: I am the chemical upon which all life ultimately depends. The leaves of the oak were green with me.

CARBON DIOXIDE: Through pores called stomata, I entered the underside of the leaves.

PHOTOSYNTHESIS: During my process, chlorophyll used sunlight to change carbon dioxide and water into glucose or food molecules and a by-product — oxygen. So you see, because of me, the tree received nourishment and the environment got the gift of oxygen.

AUXIN: I helped out with all of this by turning each leaf in the best direction to receive sunlight. This was easy for me to do because I am a hormone with the ability to detect light. Of course, my task was made easier because the oak was not heavily shaded by other trees.

PHLOEM TISSUES: You may be wondering how the tree's food traveled its tall trunk and many branches. It traveled through me. Unlike the xylem tissues, my walls were thin and stationed directly beneath the outer-bark. In my old age, some of my tissue matured into bark.

BARK: I protected the tree from harsh weather and animal attacks.

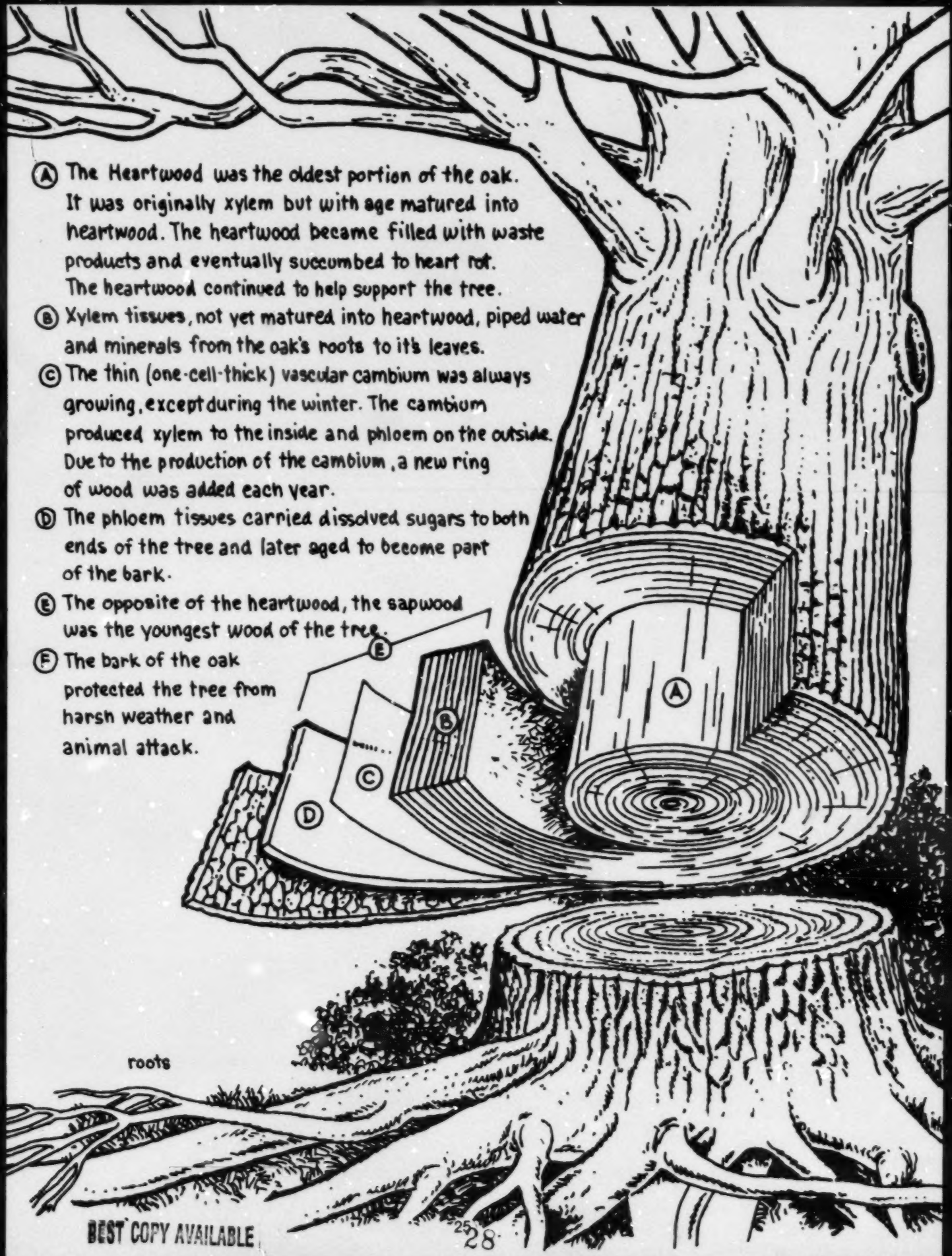
WATER: Yes, you were the armour of the tree but I was the blood of the tree. With my pressure, I kept the cells and tissues of the tree fat, strong and working properly. It was I who carried nutrient elements from the soil into the roots and throughout the body of the tree.

CAPILLARY ACTION: I am the process that pulled water from the roots of the tree upward into the leaves. During the lifetime of the oak, I pulled the pond many times over into the tree.

TRANSPIRATION: If you think the travel of all that water was a one-way trip, you are wrong. By my process, the tree released water vapor through the stomata of its leaves. On hot days I helped the tree send out hundreds of gallons of water vapor into the environment.

WATER: So you see, the oak depended on me heavily and used me wisely. When it was through with me, it recycled me back into the atmosphere, perhaps to use me again.

50 YEAR OLD TREE: Unfortunately, there was precious little water to whet my appetite during my fiftieth growing


Ⓐ The Heartwood was the oldest portion of the oak. It was originally xylem but with age matured into heartwood. The heartwood became filled with waste products and eventually succumbed to heart rot. The heartwood continued to help support the tree.
Ⓑ Xylem tissues, not yet matured into heartwood, piped water and minerals from the oak's roots to it's leaves.
Ⓒ The thin (one-cell-thick) vascular cambium was always growing, except during the winter. The cambium produced xylem to the inside and phloem on the outside. Due to the production of the cambium, a new ring of wood was added each year.
Ⓓ The phloem tissues carried dissolved sugars to both ends of the tree and later aged to become part of the bark.
Ⓔ The opposite of the heartwood, the sapwood was the youngest wood of the tree.
Ⓕ The bark of the oak protected the tree from harsh weather and animal attack.
A
B
C
D
E
F
roots

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season. As the scorching hot summer dragged on without even a drop of rain, some of my oldest branches died from lack of moisture. Late one night, a fire, probably started in the forest by campers, spread to the meadow where I stood. Feeding furiously on the dead, sun-baked grasses, the flames leaped up my trunk, ripped open my bark and scorched my inner wood. Luckily, that same night, the long awaited rains came and saved me from both the drought and the fire.

FUNGI: Quickly we made our way into the tree through its damaged bark. Eager for food, we quietly and slowly attacked the tender tissues of its wood.

75 YEAR OLD TREE: My seventy-fifth growing season was good and bad. During a violent rain storm one April afternoon, the wind tore off several of my dead branches, leaving gaping holes in my trunk. Yet, the rest of the spring was a gentle one and the summer was good for growing with plenty of sunshine and just the right amount of rainfall. Because of those favorable conditions, my cambium added a wide, healthy ring to my girth.

CAMBIUM TISSUES: I was the thin layer of tissue beneath the phloem and next to the xylem tissues. To my outside, I produced phloem and to my inside I made xylem. Together, my production added a new ring of wood to the tree each year.

XYLEM TISSUES: Yes, and by that time, the innermost rings of me were turning dark brown and they were losing their ability to pipe water and minerals through the tree. My oldest rings had become heartwood.

HEARTWOOD: Indeed, I was the oldest part of the tree. With the passing of each year, another ring of xylem matured into me.

CAMBIUM TISSUES: But for every ring that turned to heartwood, I added a new ring. These new rings gradually took over the job of piping water and minerals through the tree. So you see, I built new plumbing for the tree each year.

75 YEAR OLD TREE: Even though the wood in my core was three-quarters of a century old, my outermost wood was never more than one year old. I was, at the same time, both old and young.

SAPWOOD: I guess it's time to introduce myself. As you have already heard, the oldest wood of the tree had stopped functioning and was called heartwood. The rest of the wood, the younger xylem, cambium and phloem, was still alive and active. That wood was me.

HEARTWOOD: During the oak's one-hundredth year, I began to soften with rot. Remember the fungi that had trespassed into the tree's inner wood after its bark had been damaged by fire. Well, they were still at work on me. I had a disease known as fungal decay or heart rot.

100 YEAR OLD TREE: But never fear, I still stood strong. Unlike animal creatures, we trees can live without a heart.

CAVITIES: Yes, but you seldom live alone. We were first formed when the branches of the oak fell off, leaving holes unprotected by bark. It was through us that animals came to share life with the oak. The insects arrived first.

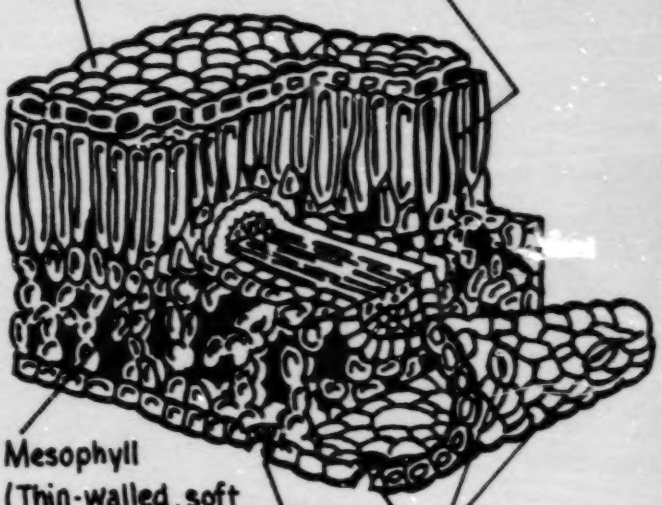
INSECTS (BEETLES, CATERPILLARS, ANTS) A CHORUS

Into the oak's fair cavities we did take
To find a good living we could make
We did burrow, dig and scoop so neat
In the old oak where juicy larvae we did eat.

acorn

Cuticle. (thin, waxy, waterproof layer covered epidermis)

Upper epidermis (protected delicate mesophyll tissue from injury, loss of water, infection)



Mesophyll (Thin-walled, soft tissues containing small round bodies known as chloroplasts which hold the green pigment chlorophyll.)

Stomata (minute openings in lower epidermis of leaf)

The main job of the oak's leaves was to make food. Carbon dioxide entered the underside of the leaves through the stomata. Chlorophyll in these cells changed the sunshine, carbon dioxide and water to glucose or food molecules. This was the process of photosynthesis.

RED-HEADED WOODPECKER: Yes I know you did, my ancestors found the oak to be a most happy hunting ground for tasty tid-bits such as yourself.

GRAY SQUIRREL: And we owe a great debt to the woodpeckers. While they pecked away in the cavities looking for food and making their nests, they made the openings large enough for my ancestors to use.

SCREECH OWL: Yes, and my ancestors found a big hollow deep in the trunk of the tree a most fitting place to raise their young.

WOOD DUCK: When the owls were not renting the apartment, my forebears raised their ducklings there.

125 YEAR OLD TREE: You are all correct. I was a good thing for the little world around the pond and the forest. Not only did I provide shelter and food to countless animals, I gave life to new generations of oaks with my acorns. My roots held the earth firm when the spring rains came. My body gave cool shade during the summer, and cut the harsh winds of winter. During the summer my leaves filtered impurities and renewed the air with oxygen.

AUTUMN: But it was during my time that the oak showed its greatness to the world. Since my daylight hours are shorter, the tree slowed its production of chlorophyll. When the green pigment of the chlorophyll began to fade, yellow pigments known as carotenoids appeared.

155 YEAR OLD TREE: Yes, I remember the autumn of my 155th year. I had grown to be a giant of a tree. My trunk was a full 8 feet in circumference and my mighty branches stretched 100 feet toward the sun. When the pond reflected the color of my autumn leaves, not a square inch of the water did not glow yellow, maize, gold, lemon saffron or mustard.

WINTER: The old oak never could keep its leaves for long. As I took over the season, the leaves would always turn brown, curl up and fall to the ground. Never once in my season did I see the tree when it did not stand naked.

SPRING: Each year I awoke the sleeping oak and it showed its renewed life by sprouting open the hundreds of green buds on its twig.

POLLEN: Not every spring, but every other, the oak used the wind to send me into the air. It was my job to travel from the staminate or male flower to the pistillate or female flower. Sometimes it was a short trip because both flowers were on the same tree. The pistillate flowers were tiny, red and without petals. The staminate flowers also had no petals but they looked like a drooping yellow catkins. By going from the male flowers to the female flowers, I made sure the seeds in the female flowers became fertile. These female flowers grew and ripened into acorns.

SUMMER: During the 225th year of the oak's life, I gave it a supreme test. I brought heat that baked the land and a drought that turned the pond into a crater of hard cracked dirt. The stream of water flowing through the tissues of the tree came to a halt. Its root system, which branched out as widely as its crown, searched desperately for a source of water in the earth, but even the most efficient root system cannot find water where there is none. In desperation, thousands of the oak's leaves curled inward in an effort to conserve moisture. But it was too late. With my drought I had strangled the giant oak.

THUNDERSTORM: It was I who finally brought an end to the drought. With a slight wind from the west, I issued a warning that I was about to let my fury fly. I flashed heat lightening across the sky and brought in a giant front of cool moist air. To back it up, I filled the air with heavy, threatening cumulonimbus clouds. A few drops fell and then I unleashed my wrath without mercy.

225 YEAR OLD TREE: Yes, I had survived storms before but I was no longer young. Fungal decay had gutted my insides, tapping much of my strength. Yet, with everything I could muster, I braced my body and roots against the onslaught of the rain and the wild, raging wind. As if it were a traitor to me, my wide crown caught the wind and threatened to pop me out of the earth.

With each slam of wind, my giant body moaned in agony. As if to herald my passing, the storm sent forth a massive crack of lightning and a tremendous blast of wind that smashed me broadside. Slowly, without hurry, my body leaned to one side. And as I groaned so loud to outshout the thunder, my trunk splintered in two. When the storm had passed and the little meadow was green and refreshed from the rain, the greater part of my trunk lay out at right angle to my stump. My crown was laying in the pond. Since my trunk was cracked open, it was easy to see what had been my achilles heel in the storm — my rotten heartwood.

DEATH: My time is the only season the old oak knows now. Yet, the old tree continues to serve life. Fungi, insects, birds, mammals, reptiles and amphibians feed and live amongst the branches and the trunk of the tree. Its rotting wood adds to the rich humus of the earth just as its fallen leaves did for two centuries. Some of its wood has been sawed and carted away by people who will use the oak to warm their homes in winter.

GRAY SQUIRREL: So here I stand on the stump of the old oak. You might say that the oak was my family tree, one oak for 225 generations of squirrels.

BOBCAT: Yeah, and you better get moving along there buddy, or that little acorn in your paw will be your next family tree.

REVIEW QUESTIONS:

1. Explain what happened to the acorn when it germinated?
2. What was the function performed by the xylem tissues of the tree? Where were the xylem tissues stationed in the tree? What did the older xylem tissues mature into?
3. What was the main function carried out by the phloem tissues? Where were the phloem tissues stationed in the tree? What did the older phloem tissues mature into?
4. Explain how the oak got its food and how it released oxygen to the environment.
5. Where were the cambium tissues stationed in the oak. What was their purpose?
6. The sapwood was the youngest, still active part of the oak's wood. The _____ was the dead, no longer functioning part of the wood.
7. Did the oak depend on wind or insects to carry its pollen?
8. Name ten animals that depended on the oak for at least part of their survival?
9. Explain how the oak served life even in death.

A Southern Flying Squirrel's Life To Live Game

Life History

The southern flying squirrel, Glauconmys volans (Linnaeus), may be common in much of Illinois' mature forests. Since the flying squirrel is active only at night, an accurate count of its numbers in Illinois has been impossible to make. The flying squirrel is protected by Illinois law and it is illegal to harm or capture individual squirrels.

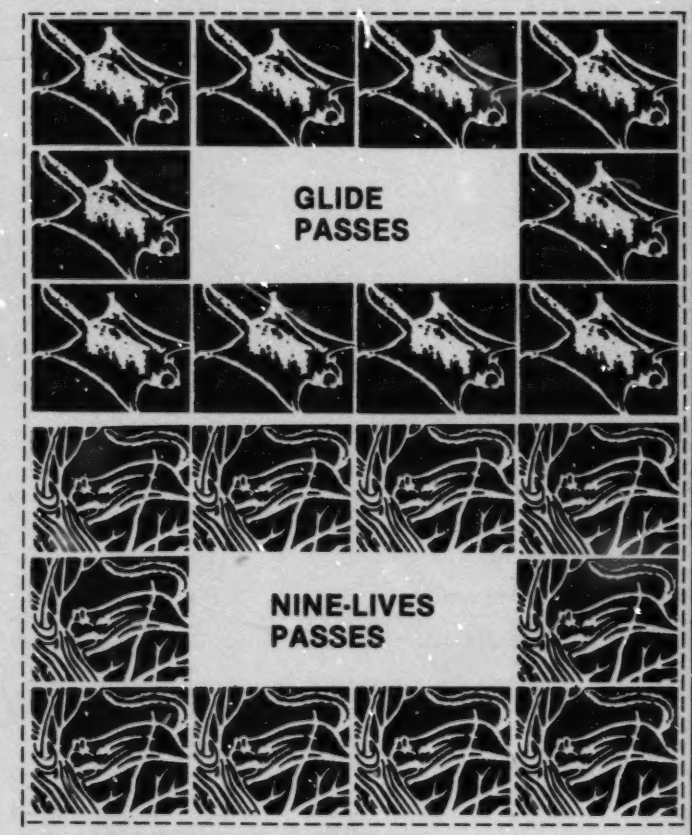
The flying squirrel is told from all other squirrels by the presence of a "gliding" membrane on each side of its body. The squirrel uses these thin folds of skin to glide from limb to limb. Contrary to what its name implies, the flying squirrel glides and does not fly. Though the flying squirrel may glide downward 150 feet or more, most of its glides are between 20 and 30 feet in length.

The female flying squirrel gives birth to 1-6 young during March to early April. She may produce a second litter in late summer. At birth the young are naked, pink, and have their eyes and ears shut. The female flying squirrel has complete responsibility for taking care of the young and she defends them and the territory around her nest tree quite courageously. The male flying squirrel, on the other hand, does not defend his home territory.

Though nuts, seeds, fruits, berries and mushrooms make up most of the flying squirrel's diet, it also feeds on animal foods such as moths, beetles, insects, insect larvae, bird eggs and nestlings, and meat from the carcasses of dead animals. In turn the flying squirrel is preyed upon by native animals such as weasels, raccoons, owls, hawks, bobcats and tree-climbing snakes. A non-native predator of the flying squirrel is the domestic cat.

The flying squirrel is active all year but it may stay in its nest for several days to avoid bad weather during the winter. Also during the winter, several flying squirrels may get together in one nest, presumably for warmth.

The flying squirrel is a beautiful and valuable member of the forest community. By feeding upon the buds of trees, the flying squirrel probably stimulates better tree growth and by eating wood-burrowing insects, it aids in controlling these sometimes harmful forms. The flying squirrel helps the forest continue by planting nuts and seeds. By serving as food for other forest dwellers, it is an important link in the food chain. Even in death, the flying squirrel serves life by adding its body waste to the soil as rich organic material.



Correct Scorecard Answers

1. Category: Natural Predator
2. Category: Food Gathering
3. Question: "NO"
4. Situation: False
5. Category: Young
6. Category: Travel
7. Question: "The presence of a gliding membrane on each side of its body"
8. VALUE BONUS: By feeding on tree buds, probably stimulates better tree growth; is beautiful and harmless.
9. Category: Habitat
10. Category: Unnatural Disturbance/Predator
11. Question: "NO"
12. Category: Nest
13. Situation: False
14. Question: "True"
15. Question: "20 to 30 feet"
16. Situation: False
17. Category: Travel
18. Category: Physical Appearance
19. Category: Natural Predator
20. Question: "Moths, beetles, insects, insect larvae, bird eggs, and nestlings."
21. Category: Habitat
22. Category: Unnatural Disturbance/Predator
23. Question: "weasel, raccoon, hawks, bobcat"
24. Situation: "True"
25. Category: Nest
26. Question: "naked, pink, and with eyes and ears shut"
27. Category: Young
28. Category: Territory
29. Question: "True"
30. VALUE BONUS: "part of the food chain; eats harmful insects; plants nuts and seeds; returns body waste to the soil
31. Category: Food Gathering
32. Category: Physical Appearance

Instructions for Playing

1. This game can be played by 1-10 players.
2. Each player should begin the game with a player token, a nine-lives pass, a glide pass and a scoresheet.
3. Before beginning the game, one player should read aloud the life history of the southern flying squirrel (see opposite page). Players should listen carefully as the information may come in handy during the course of the game.
4. To begin the game, each player should spin the spinner and the person with the lowest number is entitled to go first. The rest of the players should take their turns in clock-wise order after the first player.
5. After a player spins the spinner, s/he should move the designated number of spaces. If for any reason, the player does not want to land on a certain space, s/he can use the glide pass to land on any other space on the board. However, once a player uses the glide pass, it is no longer valid. A GLIDE PASS CAN BE USED BY ONE PLAYER ONLY ONE TIME DURING A GAME. *If at the end of the game, a player still has her or his unused Glide Pass, s/he may turn it in for 20 points.*
6. If a player lands on a CATEGORY space, the space will be marked with a number and a capital C. The player should read what is written on the space and decide which category the space refers to. The following are the categories to choose from.

CATEGORIES	
Natural Predator	Young
Unnatural Disturbances/Predator	Territory/Home Range
Food gathering	Travel
Nest	Physical Appearance
	Habitat

Each of the categories represent important parts of the flying squirrel's life history.

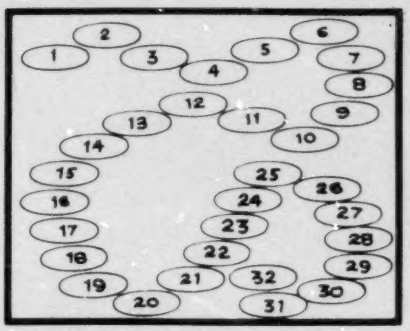
If a space seems to refer to more than one category, the player should decide what the main theme of the space is. After a player decides which category the space refers to, s/he should write down the category on her or his scoresheet opposite the number of the space. A correct answer for a CATEGORY space is worth 5 points.

7. If a player lands on a QUESTION space, the space will be marked with a number and a capital Q. The player should write the answer to the question by the number of the space on her or his scoresheet. A correct answer for a QUESTION space is worth 10 points.
8. If a player lands on a VALUE BONUS space, he or she must write down one value of the southern flying squirrel on the scoresheet next to the space with the same number. A correct answer for a VALUE BONUS space is worth 10 points.
9. If a player lands on a SITUATION space, the space will be marked with a number and a capital S. The player must decide if the drawn situation represents a true or false situation in the flying squirrel's life. The player should write true or false next to the space with the same number on her or his scorecard. A correct answer is worth 5 points.
10. If a player lands on a space where her or his squirrel is killed, s/he may avoid the death by playing her or his nine-lives pass. If the nine-lives pass is played, the player may stay in the game but is still responsible for playing that space in the appropriate manner. If a player lands on a space where her or his squirrel is killed and s/he has already played the nine-lives pass, the player must drop out of the game. However, that player can tally her or his scorecard at the end of the game and is eligible to win. Remember, like the GLIDE pass, THE NINE-LIVES PASS CAN BE USED BY ONE PLAYER ONLY ONCE DURING THE GAME. *If at the end of the game a player still has her or his unused NINE-LIVES PASS, s/he may turn it in for 10 points.*
11. After each player has crossed the finish line, a judge or a panel of the players must review the score sheets for the correct answers. The player with the highest points wins the game. Ties are permissible but run-offs in the case of a tie are advised.

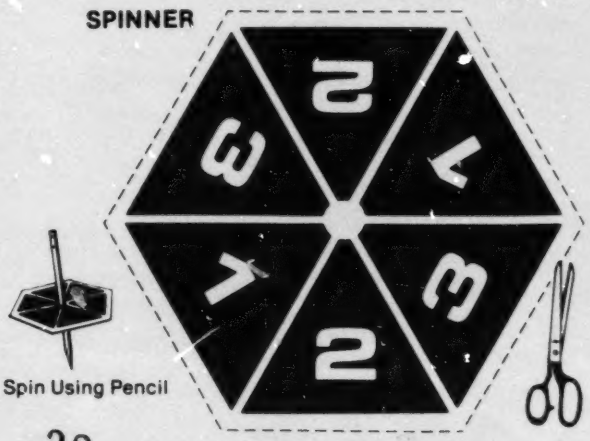
Scorecard

1. C.
2. C.
3. Q.
4. S.
5. C.
6. C.
7. Q.
8. V.B.
9. C.
10. C.
11. Q.
12. C.
13. S.
14. Q.
15. Q.
16. S.
17. C.
18. C.
19. C.
20. Q.
21. C.
22. C.
23. Q.
24. S.
25. C.
26. Q.
27. C.
28. C.
29. Q.
30. V.B.
31. C.
32. C.

GAME BOARD PLAN



SPINNER



Spin Using Pencil

32

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GAME SITUATION STATEMENTS

1. C.
It is early April and you as a female flying squirrel are returning to your nest after an hour's worth of foraging (looking for food). You find the nest is empty. A tree-climbing snake has preyed upon your young.

2. C.
Fall is approaching and the length of the days is growing shorter. It is time to begin storing hickory nuts, and acorns in your nest, in cavities or forks of trees, or even in the ground. To bury a nut in the ground, you scrape away dirt with your front feet, press the nut down with your nose and then cover the nut with dirt.

3. Q.
Do flying squirrels hibernate during the winter?

4. S.

5. C.
It is your second week of life as a flying squirrel. Since you were born, you have nearly doubled your weight and you are almost completely covered with hair. Every hour or two, your mother stands over you with her gliding membranes spread widely. In this position you nurse from her teats. Your eyes will remain closed for another two weeks. It will be four weeks before you begin to forage for your own food.

6. C.
When not gliding, you run along tree branches and leap from limb to limb. To search for food on the ground, you run and hop across the forest floor. Since you are not a fast runner, you must be especially careful to guard against predators.

7. Q.
What physical characteristic distinguishes the flying squirrel from other squirrels?

8. VALUE BONUS

9. C.
You can be a city resident. In urban areas, you live in wooded sections near buildings that people occupy. You are sometimes seen in an attic, under the eave of a roof or around a birdhouse.

10. C.
Shriek, shriek, you scream. A domestic cat has pounced at you. You run for the nearest cover. Too late! With one big swat, the cat scoops you up and bites your neck. You are a goner.

11. Q.
Is it legal to shoot, trap or capture a flying squirrel in Illinois?

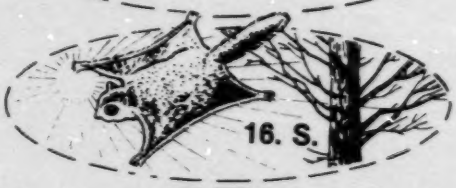
12. C.
You have found the perfect spot for your den, the abandoned nest cavity of a downy woodpecker. Even though the opening in the side of a tree is only one inch in diameter, you move in shredded bark and lichens, moss, feathers and bits of leaves to line your new home.

13. S.

14. Q.
Since flying squirrels are active only at night biologists do not know exactly how many flying squirrels there are in Illinois. True or False.

15. Q.
How far do flying squirrels normally glide?

16. S.



17. C.
You leap off a perch, spreading your four legs at a right angle to your body and stretching your gliding membranes until they catch the force of the air. Using your tail to do most of the steering you turn at a 90 degree angle to avoid a branch. Ready to land, you brake with your tail and touch down on your hind feet. You then scurry to the top of the tree where you launch off again.

18. C.
You have survived the winter and it is now March. By the end of summer the fur on your head, neck and rump will be wearing thin. Fortunately, your fur will begin to molt in September or early October. By November, you will have traded in your old coat for a new one.

19. C.
There is a full moon out. You know this night is an especially risky one. Nonetheless you lift off your perch and glide through the air. Sharp talons pierce your back and a great horned owl silently carries your body away.

20. Q.
Name one animal food taken by the flying squirrel.

21. C.
You belong to a species that is probably common in the mature woodlands of Illinois. You seem to prefer a home that is heavily wooded but not so heavily wooded as to prevent gliding and you favor forests that contain plenty of old dead trees and rotten snags well drilled with woodpecker holes and cavities.

22. C.
It is daytime and you are sleeping in the cavity of a tree. A gloved hand reaches in and jerks you out of your nest. You are so startled, you die of shock. The person who wanted you as a pet walks away empty handed.

23. Q.
In addition to tree-climbing snakes and owls, name a native animal that preys upon flying squirrels.

24. S.

25. C.
Winter is approaching. You move from your cool nest in the cavity of a hollow limb at the top of a white oak tree to a cavity deep in the trunk of the tree. The nest is protected from wind and snow and is warmer, especially since five other flying squirrels are sharing the winter nest with you.

26. Q.
Describe a flying squirrel at birth.

27. C.
You are a female flying squirrel. Lightening has just struck your nest tree and the nest is now exposed. Two of your young are dead. You must move the surviving two to a new nest. One by one, you carry the young squirrels by biting their belly skin while they curl their feet and tail around your neck.

28. C.
You are a female flying squirrel and you defend your nest tree and the area around it, about one acre. Another female flying squirrel has happened into your territory. You stare at the intruder and stomp your feet. When she does not turn back, you lunge toward her, smack her in the face and jump on her back. A struggle follows and the other squirrel scurries away.

29. Q.
Unlike the female flying squirrel, the male flying squirrel does not defend a territory. True or False.

30. VALUE BONUS

31. C.
It's no wonder you spend most of your life combing the branches of trees. Various nuts, fruits and berries are stock items on your menu. During the winter, you nibble on the buds of trees; in spring, you eat the tasty blossoms of sugar maple and the bark of many hardwood trees.

32. C.
You are about the size of an eastern chipmunk but appear slightly larger. The "gliding" membrane on each side of your body is a loose fold of skin running from your wrist to your ankle. The glossy fur on the back and sides of your body is gray, drab, or pinkish cinnamon, the under parts are pure white. From the tip of your tail to your head, you are 8 5/8 to 9 3/4 inches long.

Forest Sleuthwork

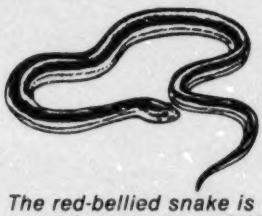
This exercise requires you to become a spy of the forest and will take you to the four locations or layers of the forest. Good luck!

Location One: The Forest Floor

Briefing: It is your mission at Location One to scour the forest floor for signs of plant and animal life.

Strategy: A. Get down on your knees and pick up a handful of forest litter.
List three items you see and feel in the litter. 1. _____ 2. _____ 3. _____
Dig with your fingers into the litter on the forest floor. What is the grainy, dark-colored substance beneath the litter? _____
B. Look under three rocks for signs of plant and animal life. Is the soil beneath the rocks cool and moist or hot and dry? _____ Do you see any plant roots running through the soil beneath the rocks? _____
Are there any insects or other animals? _____
If so, can you name them? If you do not know their names, write down a description of them. _____
_____
_____
Do you see any burrows or tunnels beneath the rocks? _____ Are there animals in the burrows? _____ Are the burrows that you see large enough to be used by the western earth snake, _____ the red-backed salamander, _____ or the springtail _____?

The eastern tiger salamander is rather large for a salamander at 7-8¼ inches in length.



The red-bellied snake is small for a snake at 8-10 inches in length.

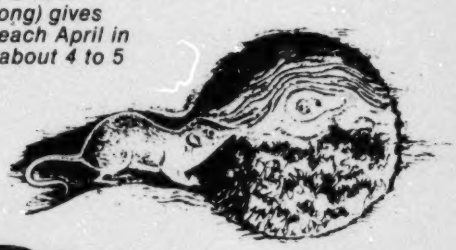
The tiny wingless springtail is only about a ¼ inch long.

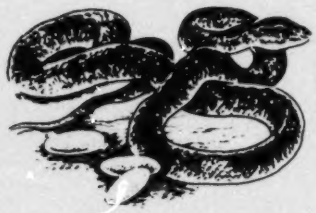
C. Locate a fallen and decaying log. Check out the bark first. Are there any types of fungi such as artist's fungus growing on the bark? _____ Is there moss such as star moss growing on the bark? _____

artist's fungus *star moss*

D. Peel off a small section of bark and examine the wood of the log. Do you see any tunnels, _____ cocoons, _____ or spider webs _____? Is the wood decayed (filled with open spaces) enough so that animals could place their nests, young and eggs in it? _____ If so, is the wood of your log big enough to hold the nest of the masked shrew _____, or the eggs of the black rat snake? _____

The female masked shrew (about 3½ inches long) gives birth to five young each April in a ball-shaped nest about 4 to 5 inches in diameter.





The stout-bodied black rat snake (about 48 inches long) lays one dozen large eggs in decaying wood.

E. Now if you can, roll the log over. Can you spy any clue of plant or animal life in the area where the log was laying. If so write down your observations.
_____
_____

Each of the animals drawn below lives at least part of its life under a decaying log. Which of the following animals would be about the right size to live beneath the log you have overturned. The hermit flower beetle _____, the white-footed mouse _____, the eastern gray tree frog _____? Be sure to carefully roll the log back over into its original position.

The 1¼ inch long hermit flower beetle is one of Illinois' larger beetles.

The white footed mouse is about 5-7 inches from head to tail.

The eastern gray tree frog is only 1¼ to 2 inches long.

F. Crisscross the forest until you find a mound of dirt that opens into an underground tunnel. Do you know which animal the tunnel is used by? _____ Is the tunnel the right size for the mole _____ or the pine vole _____?

The 3¾ to 5 inch long pine vole makes a small opening in ground surface and blazes a branching network of underground tunnels.

The chunky mole measures 5½ to 8 inches long. Using its spadelike hands, the mole moves with a "swimming" or "breaststroke" motion through its tunnels near the ground surface. When the mole is home, it plugs all openings to its tunnels so mice and shrews cannot move in and use its runways.

G. Sneak around with your head down and your eyes targeted on the forest floor. Look for mammal tracks. The forest floor is like a roadway for animals, especially mammals. Can you find any of the tracks illustrated on page 20 of this booklet. If so, which ones. _____

Location Two: The Herb Layer

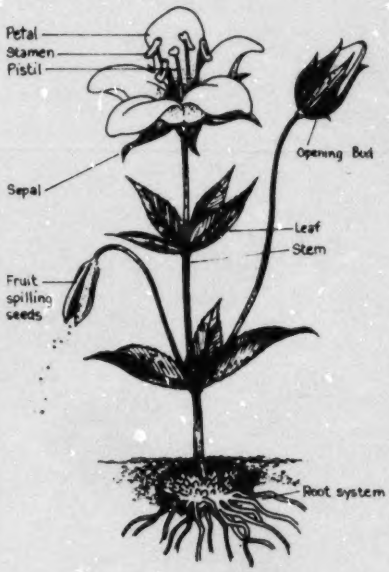
Briefing: As you walk through the forest, the small plants growing at your feet are the herbs. Herbs are green plants with soft, non-woody tissues. Most of the herbs in the forest are called wildflowers. It is your mission at Location Two to study the wildflowers and to uncover any insect activity.

Strategy:

A. Locate a wildflower. How tall is the plant you have found? _____ What colors are on the plant? _____ Smell the plant, especially the flower or blossom if it has one. Does the plant have a scent? _____ If so, describe the scent. _____

B. Now it is time to study the construction of the wildflower. Below is a drawing of a complete plant. Though the plant you have found may be different in some ways, you can use the drawing as a guide as you answer the following questions about your plant. (The exercise on the parts of a flower on page 16 of this booklet will also help you) Does the plant you have chosen have a stem? _____ Touch the stem gently, is it smooth _____ or covered with small hairs? _____ Is the stem fatter or thinner than a pencil? _____ Does your plant have leaves? _____ Can you see any buds on your plant? _____ Do you see any seeds or fruits? _____ If so, draw and describe them _____

See page 18 of this booklet for a selection of different fruit and seed types.



Draw the seed and fruit here

C. If your plant has a flower, you should investigate it thoroughly. How many flowers are there on the plant? _____ Does your flower have petals, _____ sepals, _____ a pistil, _____ or a stamen _____? Describe the flower of your plant in great detail and then draw your flower in the box provided above in the next column.

Plant drawing

D. Your wildflower is a good place to look for insects. Location Two in the forest is busy with insects who carry out the very important task of pollination. Do you see any insects on the plant you are studying? _____ If so, name, describe and/or draw the insect(s). _____

E. In order to search for more insects, move on from your plant and inspect as many different herbs in the forest as you can. Be on the look out for any of the insects drawn below. If you find insects other than those drawn below, be sure to describe, name and/or draw them.

The bumble bee and honey bee visit showy and sweet-smelling flowers in search of nectar and pollen. When a bee visits a flower, pollen from the anther brushes off onto the bee's body hairs. Sometime later, the bee combs its hairs with its hind leg and the pollen is rubbed onto a small area of the leg that is equipped with a ring of hairs to catch and hold the pollen. In this "pollen basket" the bee carries pollen from one plant to another.

The pretty-colored flower fly visits flowers, especially those that contain aphids (tiny insects) to feed on pollen. The flower fly lays its eggs in the flower and when the larvae hatch they feed on the aphids.

Though less than ½ inch long, the ambush bug lays in wait in flowers and can catch an insect as large as a bumblebee.

Location Three: Shrub and Understory

Briefing: It is your mission at Location Three to investigate the sizes of the shrubs and understory trees and to discover any bird activity.

Strategy:

A. Locate a shrub. A shrub is a small woody plant that has several stems arising from the ground at the same spot. Some shrubs are commonly called bushes. Some shrubs are small trees which eventually may grow into large trees. How tall is the shrub? _____ Name or describe the shrub (include details on leaves, branches, buds and fruits)

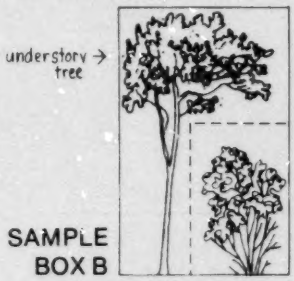
_____

How wide is the shrub? _____.

B. Draw the shrub you have found in the right hand corner of the box below. When you are done, the box should look something like SAMPLE BOX A.

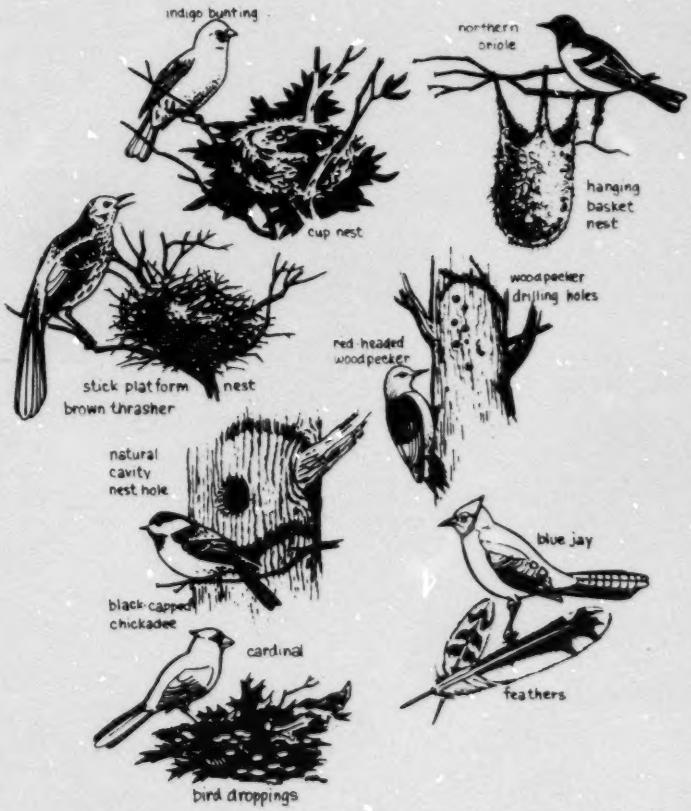
C. Shrubs are only one part of Location Three. The trees that are smaller than the largest trees are called the understory trees. Together, the understory trees and shrubs make up Location Three in the forest. Locate an understory tree. How tall is the understory tree _____?

D. Now go back to strategy B. Draw the understory tree in the same box that you drew the shrub in. Draw the tree in the space to the left of and above the dotted lines. When you are done, the box should look something like SAMPLE BOX B.



E. The branches of shrubs and understory trees in Location Three provide cover and nesting spots for many birds. One by one, investigate as many shrubs and understory trees as you can for signs of birds. These are some of the signs and birds you may find. If you spy any of these signs or birds, write it down and/or draw it in the box below. **REMEMBER: Good Forest Sleuths DO NOT TOUCH OR HARM ANIMAL NESTS.**

Signs of birds at Location 3.

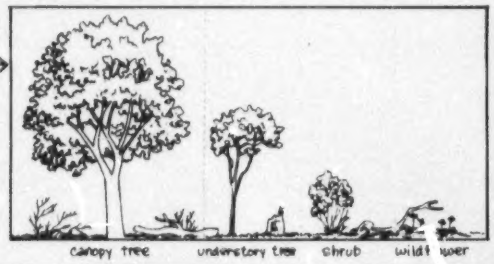


Location Four: Canopy Layer

Briefing: It is your mission at Location Four to investigate the branches, leaves and bark of the canopy trees.

Strategy:

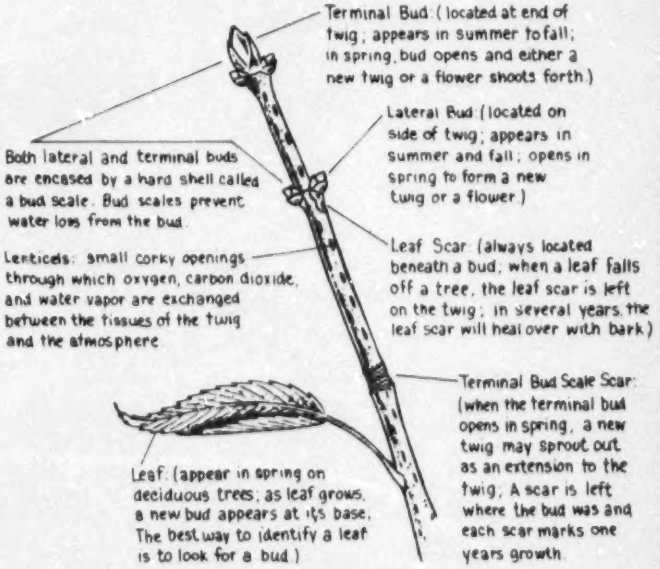
A. Select a deciduous canopy tree that has leaves (either last year's old leaves or this year's new ones) A canopy tree is one of the largest trees in the forest. Its leaves and branches form a protective umbrella over the lower layers of the forest. How tall is the canopy tree you have chosen? _____ How wide is its crown of branches? _____ In the box below, draw the wildflower you studied at LOCATION 2, the shrub and the understory tree you investigated at LOCATION 3 and finally, the canopy tree you have selected for study at this location. Be sure to draw at the base of those plants what you investigated at LOCATION 1. When you are through your box should look something like the sample box.



canopy tree | understory tree | shrub | wildflower

B. Find a twig (a small branch) on your canopy tree. Break it off as close to the main limb as possible. Use the illustration below to help you answer the following questions about your twig.

Start at the outermost end of your twig. Is there a bud? _____ If so, what is that bud called? _____ Is there a leaf or a flower growing out of the end of the twig? _____ Look on the side of the twig. Do you see any buds? _____ If so, what are those buds called? _____ Do you see any leaf scars on the twig? _____ If so, how many? _____ When the leaves fall off the twig in autumn, what mark will they leave behind on the twig? _____ Can you find a terminal bud scale scar on your twig? _____ If so, how many? _____


Terminal Bud: (located at end of twig; appears in summer to fall; in spring, bud opens and either a new twig or a flower shoots forth.)
Lateral Bud: (located on side of twig; appears in summer and fall; opens in spring to form a new twig or a flower.)
Both lateral and terminal buds are encased by a hard shell called a bud scale. Bud scales prevent water loss from the bud.
Lenticels: small corky openings through which oxygen, carbon dioxide, and water vapor are exchanged between the tissues of the twig and the atmosphere.
Leaf Scar: (always located beneath a bud; when a leaf falls off a tree, the leaf scar is left on the twig; in several years, the leaf scar will heal over with bark.)
Terminal Bud Scale Scar: (when the terminal bud opens in spring, a new twig may sprout out as an extension to the twig. A scar is left where the bud was and each scar marks one years growth.
Leaf: (appear in spring on deciduous trees; as leaf grows, a new bud appears at its base. The best way to identify a leaf is to look for a bud.)

* Special note on buds
Some buds open and grow into new twigs. Inside these buds are much shortened stems and tiny leaves, a whole new twig ready to grow.
Other buds grow into flowers. Inside these buds are tiny little flowers ready to bloom.

For Strategies C & D, turn to the next page.

BEST COPY AVAILABLE

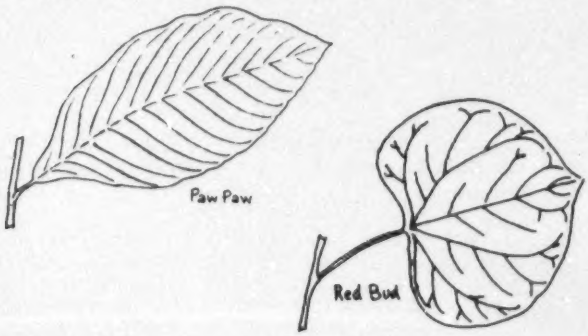
FOREST SLEUTHWORK/Location Four Continued

C. Find a leaf. Listed and drawn below are three major types of SIMPLE LEAVES and three major types of COMPOUND LEAVES. Simple leaves such as those of paw paw appear on the twig singly. Compound leaves are different from simple leaves because they are made up of many leaflets which are arranged in pairs opposite each other. Carefully study the leaf types below and then answer the following questions about the leaf you have found. After you answer the questions, draw your leaf in the box provided. Is your leaf a simple or compound leaf? _____ If it is simple, is it a simple-smooth leaf _____, a simple-lobed leaf _____, or a simple-toothed leaf _____? If your leaf is a compound leaf, is it a pinnately compound leaf _____, a palmately compound leaf _____, or a doubly pinnately compound leaf _____?

Draw your leaf in this box.

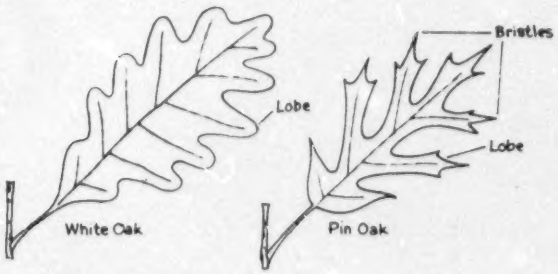
SIMPLE LEAF TYPE ONE

Simple - smooth: the edges of these leaves are smooth.



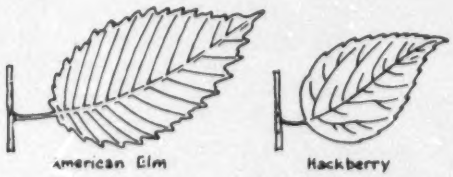
SIMPLE LEAF TYPE TWO

Simple - lobed: the edges of these leaves are cut deeply to form lobes.



SIMPLE LEAF TYPE THREE

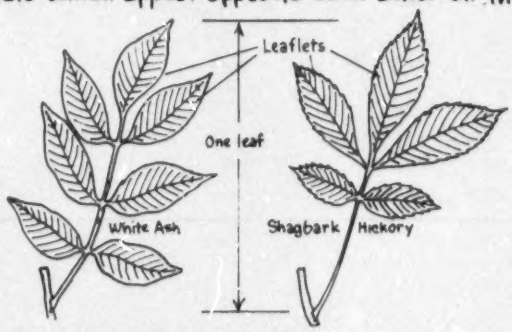
Simple-toothed: The edges of these simple leaves appear to have small teeth.



D. Take a separate piece of white paper and press it against the back of your canopy tree. While continuing to press the paper against the bark, rub a crayon over the paper so that the bark makes an impression on the paper. When you are through, attach the paper to this sheet. Congratulations! You have completed your study at LOCATION ONE through FOUR and you are now a certified FOREST SLEUTH.

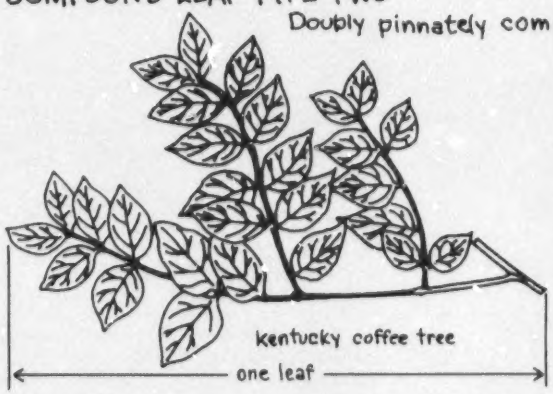
COMPOUND LEAF TYPE ONE

Pinnately Compound: These leaves are made up of many leaflets which appear opposite each other on the twig.



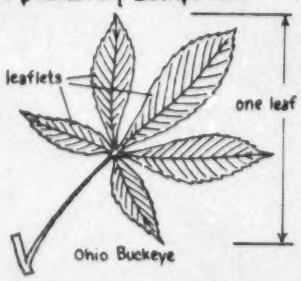
COMPOUND LEAF TYPE TWO

Doubly pinnately compound:



COMPOUND LEAF TYPE THREE

Palmately Compound: The difference between pinnately compound leaves and palmately compound leaves is that pinnately compound leaflets appear in pairs while palmately compound leaflets (usually 3-8 in number) all grow out from a central point.



FOREST MANAGEMENT — MAKING THE MOST OF OUR FORESTS

This forest collage shows many of the different things that forests provide for plants, animals and humans. Study carefully the collage and on a separate piece of paper, make a list of all the things you see in the collage that forests provide.

THE NEED FOR FORESTS IS GREAT

Your completed list demonstrates what is called the MULTIPLE USE of forests. In Illinois, forests are used for multiple reasons. Plants and animals depend on forests for natural habitats and people use forests for recreation, hunting, nature study, and for the production of lumber. When Illinois was first settled by white pioneers in the early 1800's, the state's 14 million acres of forests provided a vast habitat for plants and animals and a wonderful abundance of forest for people to use. In modern day Illinois, however, the state's supply for forest has shrunk by 10 million acres to just 3.2 million acres. Because of the shortage of forest as habitat, many forest plants and animals are fighting for survival. And to make matters worse, the growing population of people in Illinois need more forest products than ever before. **What it all boils down to is that the need for forests by plants, animals and humans is great, yet the supply of forests is shrinking.**

FOREST MANAGEMENT CAN HELP MAKE THE MOST OF OUR FORESTS

Good forest management can help make the most of the forests we have. *Forests have one great advantage; they are a renewable natural resource.* That means that forests can renew themselves by growing new trees. With good forest management, we can help forests grow bigger and healthier trees and we can even replant trees in areas that have been cleared. Forest management is the job of foresters and biologists working for state, county, local, and private organizations. To help you understand how forest managment can help close the gap between the need for forests by plants, animals and humans and the supply of forests, study the **Principles or 3P's of Forest Management** and answer the questions in **Thinking Further.**

3P(s)rinciples of Forest Management

PRESERVE—Forest management often involves setting aside some of our forests as forest preserves. These areas provide plant and animal habitat, as well as opportunities for people to study nature, hike, camp and participate in other outdoor recreation. Some of these areas provide an opportunity to hunt and fish. Since many of these areas have been preserved in the same condition they were in at the time when white settlers first came to Illinois, they are living museums of our natural heritage.

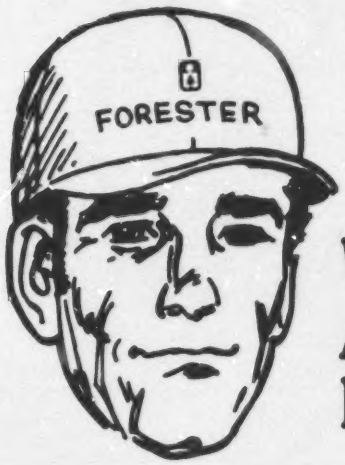
PROTECT—An important part of forest management is protection. Forest managers work to protect forests from the destruction that fire, harmful insects and grazing can cause. This also means protecting forests from being cleared when it is not absolutely necessary. When protected from harm, forests can better provide all of the things they are needed for.

PRODUCE—Since we all need forest products ranging from firewood to building materials to paper, it is important to manage some forests to produce a good crop of timber. Even though a forest will grow trees without any assistance from people, a forest manager can help it grow straighter, healthier and better-formed trees by removing some of the trees that are taking up too much space and sunlight (known as "wolf" trees) and some of the trees that are diseased, crooked or damaged. This leaves more sunlight, soil, water and nutrient elements for the healthy, straight and well-formed trees. Of course, not all of the "wolf" trees or damaged trees are removed, many are left to provide food & shelter for forest animals. The practice of removing some trees to help more valuable trees grow is called **Timber Stand Improvement. Timber Stand Improvement** is wise forest management because it helps produce better, faster-growing trees.

Another way to help a forest produce more timber is by not overcutting it. An overcut forest is one wherein all of the mature trees usable for lumber have been cut. An overcut forest provides poor habitat for plants and animals and it takes many, many years for an overcut forest to grow mature trees that can be harvested. The best way to manage a forest is to select some of the mature trees to harvest but leave many others behind as growing stock. The growing stock can then be harvested every few years as more trees mature. This type of harvesting is called **Selection Harvesting**. A forest that is harvested in this way can product timber for all of the years it is a forest. Plus, it will continue to provide habitat for plants and animals.

THINKING FURTHER

1. What is meant by the "multiple use" of forests?
2. How many acres of forests have been lost from Illinois since the early 1800's?
3. What is the one great natural advantage forests have?
4. What are the 3 P's or Principles of forest management?
5. Why is **Timber Stand Improvement** wise forest management?
6. Why is it better to **Selection Harvest** a forest than to overcut it?



WORKING AS A FORESTER

Recommending FOREST MANAGMENT PLANS for private forest landowners is a very important part of forest managment and the chief job of a FORESTER. Since 95% of the land in Illinois is owned by private landowners, FORESTERS work very closely with landowners to help them manage their woodlands in the best way possible. To complete this exercise, you will need to wear the cap of a FORESTER and it will be your job to recommend a FOREST MANAGEMENT PLAN for five Illinois landowners. You will meet those landowners and look over their land when you read the next page. These are all people who have contacted you as a FORESTER because they need advice or assistance concerning their existing or potential woodland. You should recommend to each landowner one of the five FOREST MANAGEMENT PLANS featured on this page. The choices are SELECTION HARVEST PLAN, TIMBER STAND IMPROVEMENT PLAN, FOREST PROTECTION PLAN, FOREST PRESERVATION PLAN, and TREE FARM PLAN.

FOREST PRESERVATION PLAN: A forester recommends this plan when a landowner wants to preserve his or her forest as a natural area, nature preserve, state, county or local park, a forest preserve or a conservation district. Foresters usually consult with many other persons when preparing this plan. The forester usually consults a Natural Heritage Biologist about the plant and animal species living on the property. In addition, the forester talks to different state, county or local officials about registering the property as a protected area to prevent trespassing and any other form of damage.

TREE FARM PLANTING PLAN: A Forester recommends this plan when a landowner would like to plant trees on an area that is not presently forest. The Forester visits the location and reviews the soil type and drainage patterns. If the location is suitable for raising trees , the Forester prepares a plan for the landowner that recommends which species to plant, how to plant and care for seedlings.

SELECTION HARVEST PLAN: A Forester recommends this plan when a landowner has a forest with mature trees that are ready to be harvested. This plan calls for the cutting of some of the mature trees but recommends that a good supply of trees be left in the forest as reserve growing stock and to provide habitat for plants & animals. More trees in the forest can then be harvested every several years as the trees mature. This plan allows the landowner to market part of his or her trees on a regular basis while not upsetting the forest ecosystem of plants & animals.

FOREST PROTECTION PLAN: A Forester recommends this plan when a landowner would like to protect his or her forest against fire, insects or grazing. For fire protection, Foresters may recommend putting in fire breaks. Fire breaks are narrow strips of land that have been cleared of vegetation down to the soil. These breaks stop a spreading fire and also give firefighters access to the fire. Foresters always recommend that landowners be very careful with any type of burning they do near their forests. For insect control, Foresters sometimes recommend the use of pesticides although this is unusual. For control against grazing, the advice of a Forester is simple. DO NOT GRAZE CATTLE ON WOODLANDS. Cattle kill wildflowers, fungi and young trees growing from the forest floor. Cattle also pack down the soil so that the soil can no longer hold water. This leads to serious problems of soil erosion.

TIMBER STAND IMPROVEMENT PLANS: A Forester prepares this plan when a landowner would like to improve the quality of his or her woodland. The goal of this plan is to help the forest produce healthier, better formed trees that could someday be harvested and sent to market. Timber Stand Improvement (TSI) calls for the girdling of trees that are taking up too much room (known as "wolf" trees) or diseased, crooked or damaged trees. Girdling is done by cutting a ring around the trunk of the tree. The girdled trees die and are left to decay naturally in the forest. The important thing is that the unwanted trees are no longer able to steal sunlight, water and nutrient elements from healthy well-formed trees. Of course, not all of the "wolf" trees or diseased, crooked or damaged trees are girdled. Many "wolf" trees are left because hawks and owls perch & nest in their highest branches. "Wolf" trees that are producing fruits and seeds are also left so animals can find food. Some of the diseased, crooked, or damaged trees are left because they have natural cavities where animals find shelter. Timber Stand Improvement is not a harvest but is more like a maintenance operation. TSI does for the forest the same thing hoeing does for a garden. TSI is wise forest management because it helps trees produce more good timber per acre while not harming the natural habitat for plants & animals.

LANDOWNERS

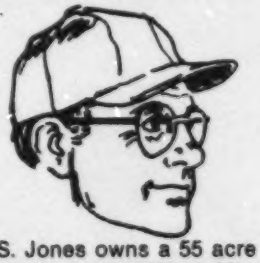
Mr. V.O. Boon owns 40 acres of forest, mostly stocked with white oak trees. When he contacted you, he said "I've got all this forest that's not doing me any good. I'm paying high taxes on the land and I need to make some money from it. I think I'll just bulldoze the whole thing and plant some corn". Several days later you inventory Mr. Boon's forest and find that the mature trees, if harvested, could produce 28,000 board feet of timber worth $22,400.00 on the veneer market. In addition, you find a very good supply of younger trees that could be left in the forest as growing stock. That growing stock could be harvested later on a sustained yield basis to provide money for Mr. Boon and his family for many years to come. You show your findings to Mr. Boon and explain that he need not bulldoze his forest. Instead, he could manage his forest as a crop just as a farmer manages a field of corn or soybeans. And you point out to Mr. Boon that he could harvest his forest to make money and still have it as a place to watch wildlife, camp, picnic and hunt. After Mr. Boon agrees to your advice, you prepare a _____ _____ Plan.

Mr. T.H. Olson owns a 200 acre forest. When he contacted you, he said "Our forest has been in our family for 150 years. My ancestors were some of the first white settlers to come to these parts. We've always harvested most of our forest but there's one 55 acre tract of white oak we've left untouched. That stand has some of the biggest, most majestic oaks you've ever seen. Some of those trees are probably five times as old as I am and I'm a pretty old codger. I tell you that stand has so many birds and mammals living in it and the forest floor is just carpeted with beautiful little wildflowers. I'd like to make sure this stand is kept the way it's always been. Why, its a real life record of what Illinois was made of before all of us humans showed up on the scene. Can you help me get it set up to preserve this stand as an example of our natural heritage"? To help you out in this case, you call in a Natural Heritage Biologist and the two of you take a walk with Mr. Olson through his stand of white oaks. The Natural Heritage Biologist points out that the stand is unique because the trees are indeed over 300 years old. Knowing that Mr. Olson wants to preserve the stand, you recommend a _____ _____ Plan.

Mrs. N.Y. Mayhan owns a large farm. On this farm, there is a mixture of pasture and cropland. When Mrs. Mayhan called you she said "I love trees so much but we just don't have many on our property. I'd like to start a tree farm somewhere on my land. I know it will take several years for the trees to grow large if I plant them now but I'm a pretty young person and besides, my children will certainly be able to enjoy them. I figure it could be an investment too. Someday, we could

harvest some of those trees. I tell you what, we've got five people in our family and I'd like to plant four acres of seedlings for each of us. Could you give me some advice on where, how, and when to plant"? Upon inspection of Mrs. Mayhan's property, you find a 20 acre abandoned pasture near the house with the right soil conditions for raising hardwood species such as white oak, red oak and black walnut. Mrs. Mayhan agrees that the pasture would be a good place to begin planting. Knowing that Mrs. Mayhan will need detailed and accurate information about tree planting, you recommend a _____ _____ Plan.

Ms. M.B. Adams owns a 50 acre tract of oak, ash and hickory forest. When she contacted you, she said, "I have this lovely woodland and I don't know what to do with it. I don't want to harvest it now but I'd like to harvest it later when my children are ready to go to college to help pay for their tuitions. Is there anything I can do to help my woodland produce the best crop of trees it can"? During a visit to Ms. Adam's forest, you find a good supply of well-formed healthy trees. However, there are a lot of diseased, damaged, crooked, and wolf trees stealing sunlight, water, space and nutrient elements from the healthy well-formed trees. Without those problem trees, Ms. Adam's forest would produce a better crop of trees. Since Ms. Adam's wants to improve her forest, you decide to recommend a _____ _____ Plan.



Mr. J.S. Jones owns a 55 acre forest stocked with oak, ash and maple species. When Mr. J.S. Jones called you he said "My woodland appears to be in bad shape. It used to be that I could go into my woodland and find a whole mess of new trees sprouting up. And I used to be able to find mushrooms and beautiful wildflowers in the spring. I walk through the woods now and its practically bare except for the larger trees. To make matters worse, the soil in my woods is all packed down and when it rains, the water just washes down the slopes of the forest into the creek, carrying what looks like half of the soil with it. What in the heck is the matter with my woods and what can I do to protect it?" When you inspect Mr. Jones' property, you find that he is grazing cattle in the forest. Since Mr. Jones wants to protect his forest, you recommend a _____ _____ Plan.

PREPARING A TIMBER STAND IMPROVEMENT PLAN

In the previous exercise, you worked as a FORESTER and recommended a forest management plan for five landowners. For one of those landowners, you recommended a Timber Stand Improvement (TSI) Plan. It is your job in this exercise to continue working as a FORESTER and to complete the details of the TSI Plan. On pages 40 and 41, a sample plot of a forest is drawn. Tape the two pages together and you will have 20 trees as they are arranged in the sample plot. The sample plot is from the forest owned by the landowner for whom you prepared the TSI plan on page 38. To complete the details of the TSI Plan you should study the drawing and description of each of the trees in the sample plot and then prepare a TSI Plan for the sample plot. A blank TSI Plan is provided for you below. Before you begin to work, review the description of a TSI Plan on page 37 and the situation of the landowner (on page 38), and study carefully the RULES OF THUMB FOR A TSI PLAN listed below.

RULES OF THUMB FOR A TSI PLAN

INTRODUCTION: The following are the rules a FORESTER follows when deciding which trees to remove and which trees to leave in a forest as part of a TSI Plan. Some of the rules have exceptions. The exceptions are just as important as the rules and should be considered carefully. Trees that are marked to be removed are usually not actually cut and removed from the forest. In most cases, the trees are girdled and left to decay naturally.

As you work to prepare your plan, keep in mind that the goal of TSI is to help the forest grow bigger, healthier, and better-formed trees by removing some of the "wolf" trees and crooked, diseased or damaged trees. But always remember, the good forester always leaves some of those trees to provide food and natural cavities or shelter for forest animals.

1. Leave all healthy, understory trees and shrubs. They are not competing with the larger trees for sunlight and are an important part of the forest ecosystem.
2. Leave the young, healthy and well-formed canopy trees. These trees will continue to grow and are providing food and shelter for animals.
3. Leave the mature healthy and well-formed canopy trees. These trees can be harvested later and in the meantime, are providing food and shelter for animals.
4. Leave the dead trees. These trees provide good natural cavities for animals and they are not taking sunlight, water or nutrient elements from live trees.
5. Remove crooked trees. They will never be useful as saw timber and they take up too much space and they tend to reproduce other crooked trees. **Exception:** Leave a poorly formed tree if it is a valuable species such as black walnut. Though the tree will not produce good timber it will put out seed for new generations of its species in the forest.
6. Remove trees that have been badly damaged by lightning, disease, insects or fire. These trees will never be valuable as saw timber and are taking sunlight, water and nutrient elements from well-formed trees. **Exception:** Leave some damaged trees if they are providing food or cavities for animals.
7. Remove trees that are gutted by fungi. Because these trees are usually rotten inside they are often said to have "heart rot". Again, these trees are stealing valuable sunlight, water and nutrient elements from well-formed trees. **Exception:** Leave some trees with "heart rot" if they are providing cavities for animals.
8. Remove "wolf" trees. "Wolf" trees are trees with an exceptionally wide crown of branches. "Wolf" trees sometimes take up five times the space a well-formed tree requires. "Wolf" trees retard the growth of other trees by shading them too heavily. **Exception:** Leave some "wolf" trees to provide nuts and other fruits for wildlife. Also, leave some "wolf" trees since hawks and squirrels nest and perch in their highest branches and since owls, woodpeckers and chickadees use cavities in their trunks and lower branches.
9. Remove less desirable trees that do not produce quality timber if they are shading more valuable trees. For example, in some forests, black locust is a less desirable species. **Exception:** Leave a less desirable tree if it is a good wildlife food producer. Red mulberry is an example of a less desirable species in terms of poor timber quality but FORESTERS usually leave it since its berries provide good food for forest animals.

TIMBER STAND IMPROVEMENT PLAN

PREPARED BY _____

NAME OF LANDOWNER _____

GOAL OF PLAN (What this plan will do for the forest)

_____

_____

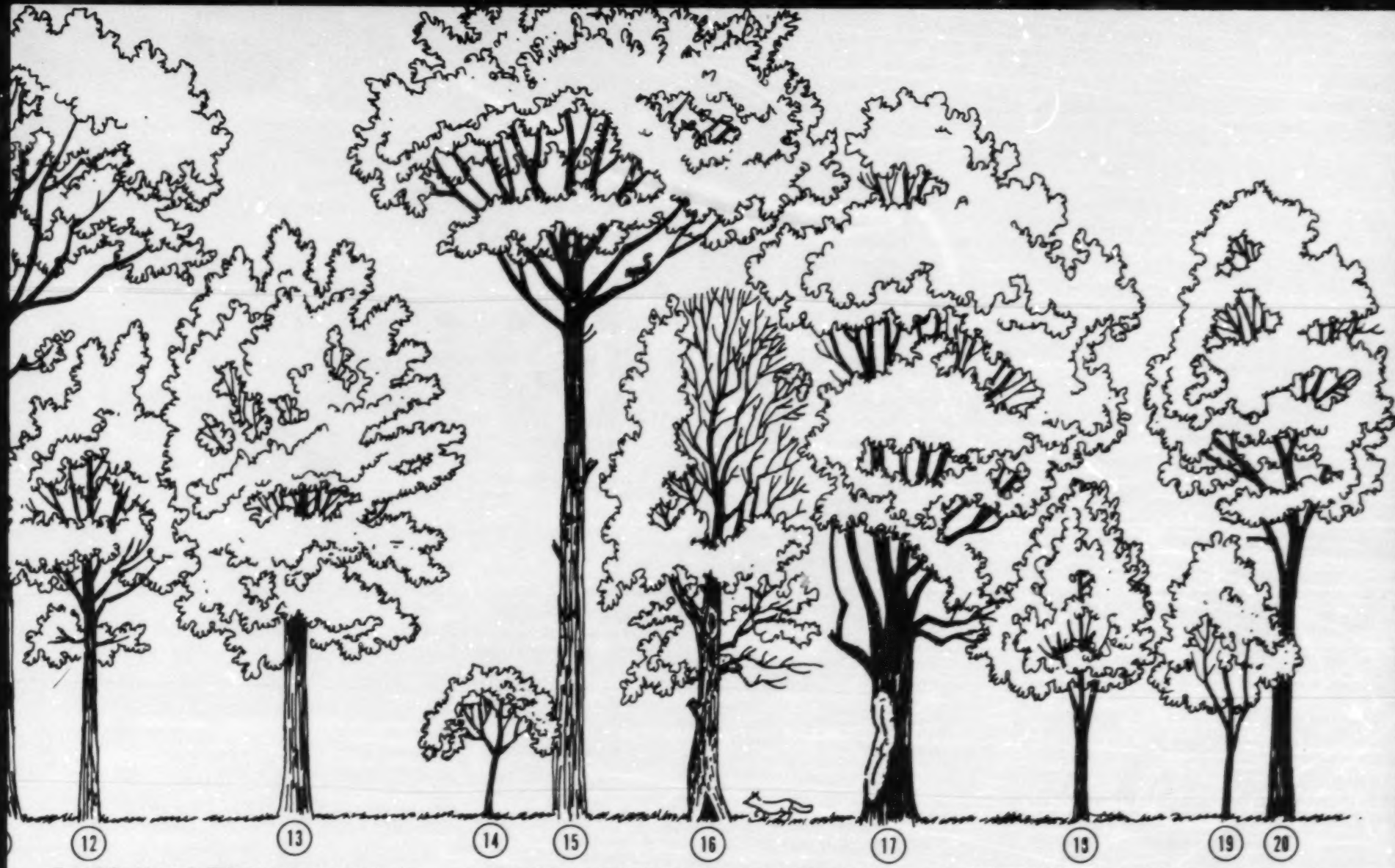
_____

DETAILS OF PLAN

The 20 trees in the sample plot are listed below. In the space beside each tree, write the species of the tree, and either REMOVE or LEAVE. Then use the rest of the space to explain your reasoning. Use this sample as a guide.

Tree #99 White Oak: REMOVE. Tree is crooked, does not have cavities for animals and is stealing sunlight, water and nutrient elements from the well-formed trees.

TREE # 1. _____
TREE # 2. _____
TREE # 3. _____
TREE # 4. _____
TREE # 5. _____
TREE # 6. _____
TREE # 7. _____
TREE # 8. _____
TREE # 9. _____
TREE #10. _____
TREE #11. _____
TREE #12. _____
TREE #13. _____
TREE #14. _____
TREE #15. _____
TREE #16. _____
TREE #17. _____
TREE #18. _____
TREE #19. _____
TREE #20. _____



Tree #13 white oak: This mature canopy tree is healthy and well formed.

Tree #14 red bud: This is a healthy shrub.

Tree #15 white oak: This wolf tree is a good producer of acorns and does not interfere with the growth of other trees.

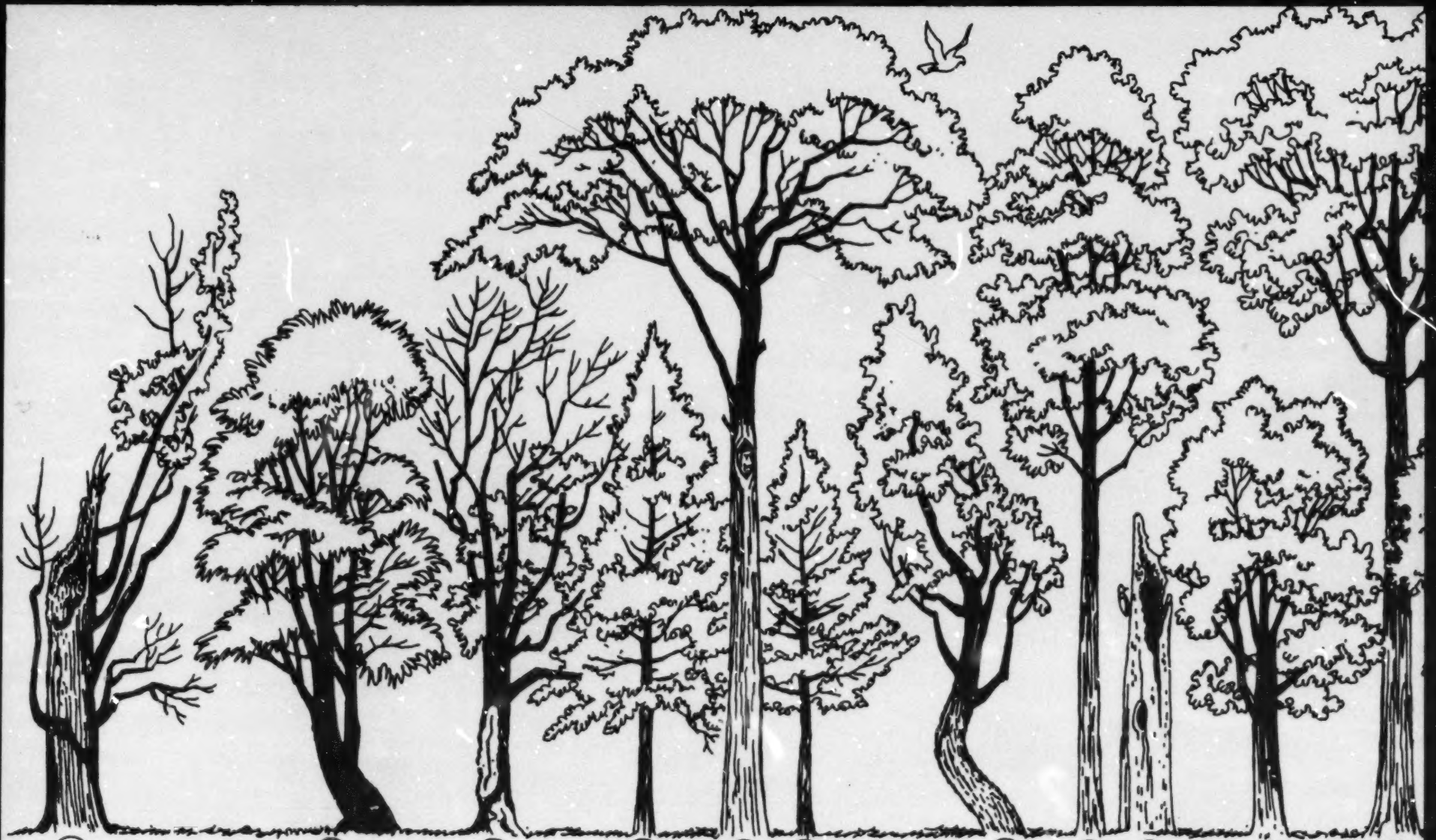
Tree #16 shagbark hickory: This tree is damaged by fungi but has a natural den at its base and cavities in its trunk and branches.

Tree #17 black oak: This tree is gutted by heart rot and is heavily shading Tree #18. This tree does not have as many cavities as Tree #16.

Tree #18 wild black cherry: This is a healthy tree that would grow faster if not shaded by Tree #17.

Tree #19 wild plum: This is a healthy understory tree.

Tree #20 black locust: This is an undesirable species that has little value as a wildlife food producer. This tree is competing with Tree #18.



TREE DESCRIPTION

Tree #1 white oak: This tree was hit and badly damaged by lightning.

Tree #2 black walnut: Though this tree has poor form, it is the only black walnut tree in the forest.

Tree #3 red oak: This tree is diseased and has little value as a wildlife cavity tree.

Tree #4 blue beech: This is a healthy understory tree.

Tree #5 black oak: This is a wolf tree. Squirrels and hawks nest in its mast of branches. Other animals nest in its cavities.

Tree #6 hop hornbeam: This is a healthy understory tree.

Tree #7 red oak: This tree is crooked.

Tree #8 shagbark hickory: This mature canopy tree is healthy and well formed.

Tree #9 white oak: This dead tree is an excellent home for animals and does not interfere with living trees.

Tree #10 red oak: This young canopy tree would grow faster if it was not shaded by tree #11.

Tree #11 white oak: This is a wolf tree with few dens for animals.

Tree #12 white oak: This young canopy tree would grow faster if not shaded by tree #11.

Land Use Planning

Introduction: (Read aloud by one student to the class)

"Carefully planning the use of the land in Illinois is very important because there is only so much land to go around. Every time something new needs to be built, the question arises as to where to put it. For example, when the people of a town decide to build a new shopping center, should they build the center on natural land such as forest, wetland, or prairie or on land that is used as cropland? The decision is never easy and a PLANNING COMMISSION is usually formed to settle the question. In making a decision, the COMMISSION considers the interests of everyone that may be affected by the decision. For example, if cropland is involved, the COMMISSION listens to farmers who are usually reluctant to lose cropland. And if natural land is involved, the COMMISSION listens to outdoorspeople (including hikers, campers, hunters, and naturalists) who usually do not wish to lose acres of forest, wetland or prairie. And even though, they cannot speak for themselves, the COMMISSION considers the needs of plants and animals who depend on natural lands as places to find shelter and food and to reproduce and raise their young. No matter what kind of land is being considered for use, the COMMISSION studies the position of businesspeople who usually want the new development to be built near roads and business areas.

"This exercise is a class project that involves land use planning. As a class, we are asked to act as a PLANNING COMMISSION for ILNI TOWN, ILLINOIS. And as a PLANNING COMMISSION, we will plan the location of a new airport for ILNI TOWN. Since the land use planning process involves many steps, our class should follow STEPS 1-7 before we recommend the placement of a new airport for ILNI TOWN."

STEP ONE: FORMING A PLANNING COMMISSION (This step should be read aloud to the class by another student)

"To form a PLANNING COMMISSION, we as a class, should elect one student to the position of PLANNING CHAIRPERSON. The PLANNING CHAIRPERSON is responsible for making sure STEPS 2-7 are followed correctly. Once a PLANNING CHAIRPERSON is chosen, the CHAIRPERSON should divide our class into 5 groups. The CHAIRPERSON should then assign the students in each of those groups to represent the 5 special-interest groups that make up the PLANNING COMMISSION. Those groups are the following: FARMERS, TREE FARMERS, PLANTS/ANIMALS, BUSINESSPEOPLE, OUTDOORSPEOPLE. Each student in those 5 groups should make a name tag that says which group he or she belongs to. Each student should pin that name tag on his or her shirt or blouse." *(After a CHAIRPERSON and the 5 special-interest groups have been formed the Planning Commission will be complete, and the class can move to STEP TWO.)*

STEP TWO: APPOINTING SPECIAL-INTEREST GROUP SPOKESPERSONS (Read aloud by CHAIRPERSON)

"It is my first duty as PLANNING CHAIRPERSON to appoint a spokesperson for each of the special-interest groups." *(Chairman should appoint 5 spokespersons and class should move to STEP THREE).*

STEP THREE: LOOKING AT THE NEEDS OF THE SPECIAL-INTEREST GROUPS
(Read aloud by PLANNING CHAIRPERSON)

"It is now time for our class as the PLANNING COMMISSION for ILNI TOWN, to look at the needs of the special-interest groups. I ask now that the spokesperson for each group present to the Commission the special interests of her or his group."

FARMERS: (Read aloud by Spokesperson for FARMERS)

"The FARMERS do not want the airport to be built on or near cropland. If it is built on cropland, we will lose more of the land that supplies us all with food. If it is built near cropland, there will be more traffic, noise and air pollution, vandalism and littering on boundaries of the cropland."

BUSINESS PEOPLE: (Read by Spokesperson for BUSINESSPEOPLE)

"We want the airport to be built near a major road. We also want the airport to be near either the downtown area or the shopping mall. Since the townspeople will have to pay for the airport, we feel the airport should be built on the land that can be purchased for the lowest price. The Businesspeople want what is best for the businesses and the overall economy of ILNI TOWN."

OUTDOORSPEOPLE: (Read by Spokesperson for OUTDOORSPEOPLE)

"We are a group made up of everyone who enjoys natural land. We are hunters, fishermen, wildlife photographers, cross-country skiers, hikers, and campers. And we are naturalists who enjoy natural areas as places to simply watch and study nature. We do not want the airport to be built in or near a natural land area. We feel that the airport would take up too much natural land and we don't have much natural land to spare."

TREE FARMERS: (Read by Spokesperson for TREE FARMERS)

"The TREE FARMERS do not want the airport to be built on forestland that is harvested to produce the wood we all depend upon. If the airport is built in a tree farm, there will be less trees for plants and animals and less trees to harvest to make lumber to build houses, schools and furniture."

PLANTS/ANIMALS: (Read by Spokesperson for PLANTS/ANIMALS)

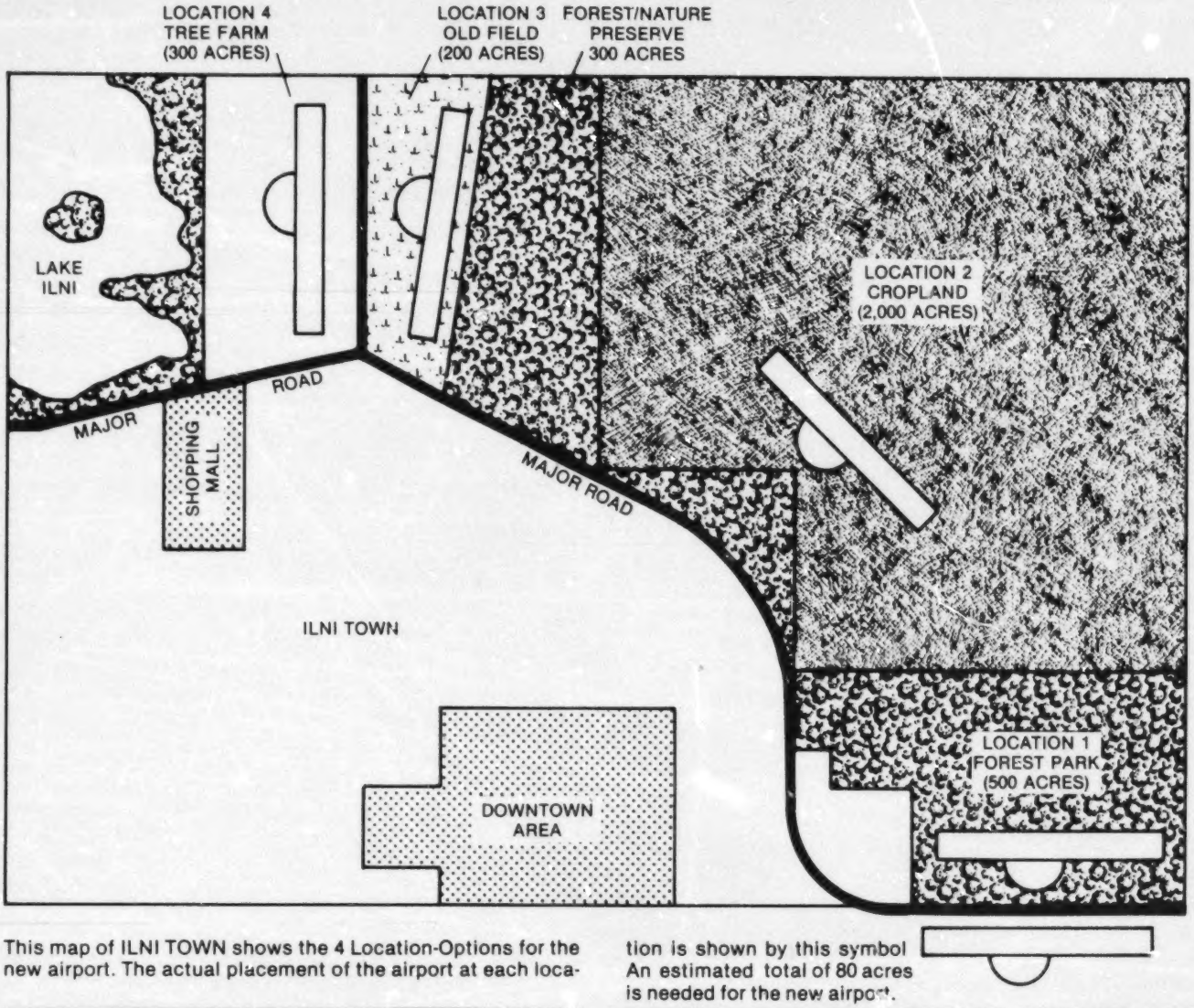
"We represent a group that cannot tell us what they want but we know that plants and animals need a natural place to live where they can find food and shelter. Therefore, we do not want the airport to be built in or near a natural habitat. The construction, traffic, air and noise pollution of an airport might destroy the habitat for plants and drive many animals from their natural homes."

(After the spokesperson for each group has presented the interests of his or her group, the class should move to STEP FOUR)

STEP FOUR: STUDYING THE LOCATION-OPTIONS: (Read aloud by PLANNING CHAIRPERSON)

"Now that the Commission has heard the needs of the 5 special-interest groups, it is time to study the 4 Location-Options for the new airport. I will read a description of each location as well as the advantages and disadvantages of placing the airport at that location. As I read the description of each location, each member of the Commission should look at the location on the map of ILNI TOWN.

LOCATION 1 is a 500 acre forest park. An acre of LOCATION 1 would sell for $2,500.00 an acre. The forest park is a natural habitat for many forest plants and animals, including several "endangered and threatened" species including goldenseal, ginseng, bobcat and Cooper's hawk. The forest park is open to many forms of outdoor recreation including camping, hiking and nature study. The forest preserve is also



This map of ILNI TOWN shows the 4 Location-Options for the new airport. The actual placement of the airport at each location is shown by this symbol An estimated total of 80 acres is needed for the new airport.

open to hunting. *Advantage:* The airport would be close to a major road and to the downtown area. *Disadvantage:* Placement of the airport in the forest park would ruin the natural habitat for plants and animals in some parts of the park and harm the natural habitat in other parts. Placement of the airport here would also limit the use of the forest park by outdoorspeople.

LOCATION 2: LOCATION 2 is a 2,000 acre tract of cropland. An acre of LOCATION 2 would sell for $4,000.00. LOCATION 2 is farmed by area farmers and produces part of the food supply for ILNI TOWN and the state of Illinois. *ADVANTAGE:* No natural land would have to be cleared if the airport is built in Location 2. *DISADVANTAGE:* A new major road would have to be built to connect the new airport with the exisitng major road. Cropland would be lost and less food would be produced from LOCATION 2.

LOCATION 3: LOCATION 3 is an old field that borders directly on the Forest Nature Preserve. The old field is abandoned and would sell at a rate of $1,500.00 an acre. The Forest Nature Preserve is a unique forest since it has oak, hickory and walnut trees that are several hundred years old. The Forest Nature Preserve is used by outdoorspeople as a place to hike and study nature. The Forest Nature Preserve is closed to hunting and camping. The Forest Nature Preserve provides an excellent home for plants and animals, including wildflowers such as harbinger of spring, and dutchman's breeches and animals such as pileated woodpecker, gray fox and eastern chipmunk. *ADVANTAGE:* The land could be purchased for the lowest price. The airport would be near a major road and close to the shopping mall. *DISADVANTAGE:* The construction, increase in traffic, noise and air pollution, vandalism and littering could disturb the forest ecosystem within the Nature Preserve.

LOCATION 4: LOCATION 4 is a 300 acre Tree Farm. An acre of the tree farm would sell for $4,000.00 an acre. The tree farm produces a large amount of oak and walnut lumber each year for use by the townspeople and by people from all over the state. The tree farm is closed to hunting and fishing but all other forms of outdoor recreation such as hiking, camping and nature study are allowed. The Tree Farm provides a good forest habitat for many plants and animals such as spring beauty and white-tailed deer, barred owl and eastern gray tree frog. *ADVANTAGE:* The airport would be near a major road and close to the shopping mall. *DISADVANTAGE:* Approximately half of the Tree Farm (150 acres) would have to be cleared to make room for the airport, a road, and proper runway clearance. The natural habitat for plants and animals would be harmed and the opportunities provided for outdoorspeople would be cut in half. The Tree Farm would produce only half or less of the amount of lumber it produces now.

(After the 4 Location-Options have been reviewed, the class should move to STEP FIVE)

STEP FIVE: PREPARING RECOMMENDATIONS (Read aloud by PLANNING CHAIRPERSON)

"As PLANNING CHAIRPERSON, I now ask that each special-interest group meet by themselves and prepare a RECOMMENDATION FORM for the placement of the airport. The Spokesperson of each group is in charge of making sure that the members of his or her group discuss the 4 location-options thoroughly before a RECOMMENDATION FORM is drawn up.

(The 5 special-interest groups should meet by themselves to discuss the location-options and prepare a RECOMMENDATION FORM. Once all of the RECOMMENDATION FORMS have been turned into the Chairperson, the class should move to STEP SIX).

STEP SIX: STUDYING THE RECOMMENDATION FORMS (Read aloud by CHAIRPERSON)

"It is time now for the PLANNING COMMISSION to study the RECOMMENDATION FORMS submitted by the five special-interest groups. To do that, I would like to ask the spokesperson for each group to present the RECOMMENDATION FORM of his or her group to the Commission.

(The Spokesperson for each group should stand before the class and orally present the RECOMMENDATION FORM of his or her group to the class. The spokesperson should explain how his or her own group feels about the placement of the airport at each of the location-options. At the end of the presentation, the spokesperson should explain to the class which location-option his or her group chose as the site for the new airport and why. After all of the RECOMMENDATION FORMS have been prepared, the class should move to STEP SEVEN.)

STEP SEVEN: MAKING A FINAL DECISION. (Read aloud by CHAIRPERSON)

Now that the PLANNING COMMISSION has heard the Recommendations of the five special-interest groups, it is time for the COMMISSION to make a final recommendation. I ask now for all of the students to take off their name tags. They should no longer think of themselves as members of a special-interest group but rather as individual members of the Planning Commission. The members of the Commission will now vote on the five RECOMMENDATION FORMS submitted by the special-interest groups. Students should vote for their own preference and not necessarily for the choice of their special-interest group. The RECOMMENDATION FORM that receives the most votes will become the final recommendation of this Commission for the placement of a new airport for ILNI TOWN.

(After the vote has been taken and one RECOMMENDATION FORM has been chosen, the CHAIRPERSON should announce the choice to the class and circle the location on the map.)

RECOMMENDATION FORM

1. Name of Town: _____
2. Type of project being planned for: _____
3. Reasons why project should be built: _____
4. Total acreage project will require: _____
5. Name of Special Interest Group Preparing This Recommendation: _____
6. The special concerns of this group concerning the project. (List here what your group wants in relation to the placement of the new airport. You may wish to review your group's statement in STEP 3). _____
7. Evaluation of Location-Options. (Write a description of each location, including the type of land, total acres and what the land is currently used for. Then list the advantages and disadvantages of placing the airport at each location).

LOCATION 1: Description: _____

Advantage: _____

Disadvantage: _____

LOCATION 2: Description: _____

Advantage: _____

Disadvantage: _____

LOCATION 3: Description: _____

Advantage: _____

Disadvantage: _____

LOCATION 4: Description: _____

Advantage: _____

Disadvantage: _____

8. *Final Recommendation* (Write here the final recommendation of your group for the placement of the airport. Be sure to state why this location is the best choice.) _____